MONTHLY WEATHER REVIEW,

DECEMBER, 1880.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to January 20th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 144 Signal Service stations and 14 Canadian stations, as telegraphed to this office; 182 monthly journals and 168 monthly means from the former, and 14 monthly means from the latter; reports from 3 Sunset stations; 248 monthly registers from Voluntary Observers; 60 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Services of Iowa and Missouri and of the Central Pacific Railway Co.; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

Upon Chart No. II is shown by the isobaric lines (in black), the distribution of atmospheric pressures over the United States for December, 1880. The area of highest pressure lies somewhat farther westward than usual and covers the greater part of the country from the Mississippi valley westward to the eastern Rocky Mountain slope. On the Pacific slope, the high-pressure prevailed on the southern instead of the northern coast.

Departures from Normal Values for the Month.—By comparison with the average for the past eight or nine years, it is found that the barometric pressure for December, 1880, ranged from 0.05 inch to 0.10 below the mean in the Atlantic States; greatest departures, —0.10 at Norfolk and Wilmington, and —0.12 at New Haven and Wood's Holl. Over the Missouri and Upper Mississippi valleys, an equal excess of pressure prevailed; greatest departures, +0.05 inch at Keokuk, La Crosse and St. Paul in the latter, and +0.11 at Bismarck and Yankton in the former, district. On the Pacific coast, the pressure was normal at San Diego, 0.10 below it at San Francisco, and 0.24 below at Portland, Oregon.

Local Barometric Ranges, from readings reduced to sea-level, were greater than usual, and exceeded 0.75 inch over the entire country, except southern Florida, southern California and at a few scattered stations in the southern Plateau district. The ranges in the Atlantic and Gulf States generally varied but little from 1.00 inch. The greatest ranges were in that portion of the Lake region and Upper Mississippi valley, over which the centre of low-area No. V passed; they increased gradually northeastward from 1.47 at Leavenworth to 1.79 (the largest in the country) at Escanaba. The smallest range was 0.49 at Key West. Other noticeable ranges were 1.70 at Dodge City, 1.48 at Missoula and 1.27 at Umatilla.

General Barometric Range.—The extreme range of the atmospheric pressure, reduced to sea-level, was 2.15 inches, from 30.97 at Fort Buford on the 26th, to 28.82 at Dodge City on the 4th.

Areas of High Pressure during December, 1880, were eight in number, three of which were slight and unimportant encroachments of high pressures from the Pacific ocean. The five other

areas were outflows of very cold air from the British possessions, and, except No. V, (which seems to have moved southward from Hudson Bay region) advanced southeastward apparently from Saskatchewan. No. VIII was the most important area, its passage being marked from the 24th to the 31st by excessively low temperatures which materially reduced the mean temperature of the month, and made in many sections the last half of the month the coldest for many years.

No. I—first showed itself as a rising pressure in the valley of the Upper Missouri on the 1st, and moving slowly eastward through the Lake region, was central in the Upper St. Lawrence valley the afternoon of the 3rd. During the 4th it withdrew southeastward off the Atlantic coast in advance of low area No. IV. The highest pressure in connection with the area was that at Fort Buford on the morning of the 2nd, 0.40 above the normal. Cautionary Signals were displayed during the 1st in the Lake region and were justified on Lake Michigan: greatest wind velocity W. 29 miles at Milwaukee. The Signal displayed at Eastport was justified by a north wind of 30 miles. In connection with this area a temperature of —25° was reported from Ft. Buford on the morning of the 3rd.

No. II.—During the 5th the pressure in the valley of the Upper Missouri rose above the normal and the area, moving slowly southeastward, on the morning of the 7th covered the Mississippi valley; Cairo barometer 30.61, or 0.40 above the normal. Withdrawing southeastward the area was slowly dissipating over the Gulf of Mexico, when it was re-enforced by high area No. III. Off-shore signals were displayed on the Texas coast during the 5th and 6th. This signal was fully justified at Galveston, but at Indianola for velocity only. The lowest temperature reported was from Fort Buford on the morning of the 6th, —37°.

No. III.—This area first appeared in the same district as the two preceding areas—the valley of the Upper Missouri. It was central during the 9th in the Upper Mississippi valley, and moving slowly eastward was in the Lake region on the 10th; Parry Sound barometer that morning 30.77 or 0.66 above the normal. Thence it moved southward through the Atlantic States and slowly withdrew from Florida eastward, or dissipated on the 11th. Cautionary Signals were displayed in the Lake region and along the New Jersey (as Off-shore,) and North Carolina coasts on the 8th. These signals were fully justified along the Atlantic coast and partly in the Lake region. The following were the highest winds reported: Buffalo N. 28, Milwaukee NW. 32, Sandusky W. 35, Cape May N. 44 and Kittyhawk N. 53. Cautionary Signals were again displayed on the North Carolina coast during the 10th, and as Off-shore from Chincoteague to Portsmouth, N. H. These Signals were fully justified, though somewhat late at all stations north of Sandy Hook. The following are the greatest wind velocities reported: Chincoteague NW. 30, Cape May NW. 44, Cape Henry NW. 46 and Newport N. 48. The lowest temperature of this area was —27° at Fort Garry on the morning of the 8th.

No. IV.—During the 9th the pressure increased steadily on the Pacific coast, and on the 10th the rise was transferred to the Plateau regions; Salt Lake barometer in the afternoon 0.37 above the normal. The area slowly dissipated in the Plateau districts during the 11th.

No. V.—This area first showed itself by a marked rise over the Upper Lake region during the 15th; Marquette barometer, p. m. of the 16th, 0.23 above the normal. The pressure remained nearly stationary until the 18th, when a new outflow of cold air from Manitoba transferred the centre to Minnesota; St. Vincent barometer, a. m. of the 19th, 0.47 above the normal. The highest pressure remained nearly unchanged, over the Lake Superior region from the 19th to the 22nd, when it moved eastward into Ontario, whence it slowly withdrew with gradually increasing pressure down the St. Lawrence valley; Father Point barometer the afternoon of the 25th, 30.52 or 0.56 above the normal. It slowly dissipated on the 26th in advance of low area No. XIII. Cautionary Signals were displayed during the 19th on the Texas coast; maximum wind reported: Indianola, NW. 36. The lowest temperature of the area was —23° at Fort Garry on the morning of the 22nd.

No. VI.—On the 17th the barometer rose rapidly in California, and on the 18th the pressure in the Southern Plateau district was considerably above the mean. Moving slowly eastward the area apparently united on the 19th in Texas with area No. V. The highest reading noted was at midnight of the latter date at Eagle Pass, 0.24 above the normal.

No. VII.—On the 24th the pressure in the Southern Plateau district, which for several days had been near the normal, rose at midnight to 0.18 above at Tucson. The pressure continued above the mean in Arizona and southern California until midnight of the 26th, when it moved eastward and united with high area No. VIII.

No. VIII—was the most important high area of the month. It first showed itself by a barometric rise over the valley of the Upper Missouri during the 24th; the next morning the temperature at Fort Garry was —35°. The pressure remained nearly stationary until the 26th, when a second rise carried the pressure at Fort Buford to 30.97. The area covered the Missouri valley until the 28th, when it moved rapidly southeastward, being central in Texas on the 29th; midnight barometer at Eagle Pass 30.65 or 0.52 above the normal. A portion of the area remaining in Texas slowly dissipated, while another part moving northeastward covered the Atlantic slope with a pressure decidedly above the mean during the 31st; Cape Henry barometer that morning 0.30 above the

normal. Cautionary Signals were displayed on Lake Michigan on the 27th (highest velocity 35 miles at Milwaukee) and on the 29th (40 miles at Grand Haven). The minimum temperatures which prevailed during the passage of this area east of the Rocky Mountains were the lowest observed over the greater part of the country for many years. As the area moved southeastward on the morning of the 28th a minimum temperature of —44° was reported from Fort Garry. At that time the temperature of the Missouri and Upper Mississippi valleys, the Upper Lake region and the northern Rocky Mountain slope was below zero. On the morning of the 29th the area over which temperatures below zero prevailed was extended to include the Ohio valley and the northern parts of Indian Territory and Texas, while at Fort Benton, Montana, a temperature of —59° was observed. This temperature (that observed at Pembina on December 24th, 1879 being the same) is the lowest ever recorded in the United States, and is within 14.°8 of the lowest ever reported on this continent; (British Arctic Expedition of 1875–76, —73°.8 at Floeberg Beach, 82° 27′ N. 173° 26′ W. in March, 1876.) On the morning of the 30th, temperatures ranging from 0° to —56° were reported from the entire Lake region, the Ohio, Upper Mississippi and Upper Missouri valleys, the Rocky Mountain slope southward to include the northern parts of Texas and New Mexico, from the greater part of New England, from the Middle States, (except southeastern Virginia), from the western half of North Carolina and eastern Tennessee. On the 31st, temperatures below zero prevailed over substantially the same region with the addition of the greater part of New Mexico and portions of Texas and New England. On that and the preceding morning freezing temperatures prevailed over the entire United States except the Pacific coast region, the southern half of Florida, and the extreme southwestern portion of Arizona. The following temperatures in Arizona and the Gulf States are noted as of interest: Tucson 35°, Cedar Keys 22°, New Orleans 20°, Jacksonville 19°, Brownsville 18°, Mobile 14°, Montgomery 8°, Augusta 7°. Much damage was done by the low temperature of this area to the sugar cane in Louisiana and adjoining states. Timely and sufficient warning, however, was given to planters so that they could take such means as would save the largest possible amount of the cane.

Areas of Low Pressure.—Sixteen such areas appeared during December, 1880. The tracks of thirteen are shown by Chart No. I. An unusually large number of these areas, six in number, first appeared on the Pacific coast; four of the number crossed the continent. One area sprang up in the Lower Lake region, one in North Carolina, two in the Gulf of Mexico and three from the Rocky Mountain region: the three remaining probably developed in Saskatchewan. No. III, as a whole, was the most severe storm, being violent on the Pacific slope, accompanied by tornadoes in Missouri, and marked in the Lake region by the lowest pressures and highest winds of the month. Nos. X, XII and XIII caused strong gales off the Pacific coast, and in connection with the last-named area, most violent northeast to northwest gales prevailed from North Carolina to Nova Scotia during the 25th and 26th. No. XV was marked by very severe gales in the Gulf of Mexico and along the entire Atlantic coast during the 29th. This area moved with unusual rapidity, its velocity east of the 100th meridian averaging seventy-five miles per hour. The paths pursued by areas for the first half of the month were, through their whole extent and without exception, to the northward of the 40th parallel. During that time, the pressure over the country was comparatively low. During the latter half of the month, the pressure over the country at large, was decidedly above the normal and, at no time, gave way so as to permit the natural movement of the low-areas eastward. In consequence, the tracks of low-areas skirted the borders of the prevailing high pressures. The areas on the Pacific slope moved southeastward along the coast, and such as have crossed the continent passed southeastward through Texas, and skirting the northern coast of the Gulf of Mexico, moved northeastward along the Atlantic coast.

No. I—was a continuation of area No. XVI, described in the November REVIEW. Central in northwestern Minnesota on the 1st, it moved northeastward into Hudson Bay Territory.

No. II—sprang up suddenly in the Lower Lake region during the night of November 30th and December 1st, and moving rapidly eastward, passed off the Massachusetts coast that afternoon; New London barometer 0.53 below the normal. Its subsequent course was probably northeastward, as severe gales were reported south of Nova Scotia during the 2nd. Cautionary Signals were displayed during the 1st in the Lower Lake region and somewhat late along the Atlantic coast, northward of Cape May, while to the southward of that station, Off-shore Signals were displayed. These signals were partly justified; the greatest wind velocities reported: Cleveland, W. 28; Cape Henry, W. 36; Point Judith, NE. 54.

No. III.—This storm was unusually violent on the Pacific coast. Off Columbia river, heavy WSW. gales, veering to NW. were experienced from November 29th to December 3d, and off the coast of southern Oregon during the 2nd and 3rd; lowest barometer 29.12, reported by the steamer *Elder*. During the 2nd, along the entire coast of California, heavy southerly gales occurred, in which one or more vessels were lost. The storm apparently moving from the northwest, entered Oregon during the 2nd; Roseburg barometer that morning, 29.26 or 0.91 below the normal. Moving very slowly southeastward, it was central in Utah at midnight of the 3rd. Its passage through California and Nevada was marked by heavy rains. At San Luis Obispo the rain-fall of the storm was 4.65 inches and Mt. St. Helena 6.65. In the Sierra Nevada Mountains along the Central Pacific

railway, four feet of snow fell upon a level. Railway travel was somewhat delayed by dangerous land-slides and heavy snow. In western Oregon, the snow-fall was from 2½ to 3 feet, east of the Cascades. The storm being followed by low temperatures in the valley of the Columbia, so blocked that river by ice above the mouth of the Willamette as to prevent any navigation until after the 12th. Below the Willamette, navigation was seriously interfered with for several days by an ice-gorge on Willow bar, four miles long. From Utah, the area moved rapidly eastward with decreasing pressure, and was central the afternoon of the 4th, in the Lower Missouri valley; Omaha barometer 0.77 below the normal. At that observation, warm (the highest temperatures of the month) southerly winds with rain, prevailed in the east and south quadrants of this area while an abnormal barometric fall of 0.33 inch in the past eight hours was reported from Des Moines and a maximum temperature from Leavenworth of 59°. At the same time in the northwest quadrant, high-area No. II was rapidly advancing, its progress marked by high NW. winds with snow, and temperatures below zero in southern Dakota (Deadwood, —11°). At midnight of the 4th, barometric low-area No. II had moved rapidly northeastward to the Upper Mississippi valley, with abnormal barometric falls in eight hours of 0.28 at Davenport and 0.29 at Milwaukee, while the following high area caused an abnormal rise of 0.31 at Omaha and 0.35 at North Platte and a fall of 39° in temperature at Leavenworth during the same time. Consequent upon such rapid changes, numerous tornadoes occurred on the 4th in southwest Missouri. They are elsewhere described under the head of *Local Storms*. On the morning of the 5th, the area was central, with greatly decreased pressure in northern Michigan; Escanaba barometer 28.92 or 1.09 below the normal. At that time the storm over the Upper Lake region (in connection with high area No. II) was unusually severe; maximum wind-velocity at Milwaukee SW. 53 miles and Duluth NW. 47. As navigation had practically closed in the Lake region, few or no disasters occurred to shipping on the lakes. On that day, in connection with these areas, the maximum wind-velocities, the lowest barometric pressures and highest temperatures of the month occurred at nearly every station in the Lake region, the Ohio, Lower Missouri and Upper Mississippi valleys. Moving rapidly northeastward down the valley of the St. Lawrence, it had reached, with increasing pressure and diminishing violence, by the afternoon of the 6th, its northeastern limits. Signals were displayed for this area in the Lake region during the 4th and 5th, and along the Atlantic coast northward of Macon during the 5th. These signals were justified with but few exceptions, though ordered somewhat late for Lake Ontario, the North Carolina and Maine coasts. The following are the highest wind-velocities reported: Cape Henry SW. 27; Eastport SE. 28; Barnegat S. 34; Buffalo W. 41; Sandusky SW. 41; Port Huron SW. 42; Duluth NW. 47; Milwaukee SW. 53.

No. IV—appears to have sprung up from the remains of No. III. As that area moved down the valley of the St. Lawrence on the morning of the 6th, the pressure fell in North Carolina; Kittyhawk barometer that afternoon, 0.37 below the normal. The track of the area is uncertain, but it probably moved northeastward to the Banks of Newfoundland in a course nearly parallel with the coast. The lowest pressure noted was at Sydney, C. B., the afternoon of the 7th, 29.39 or 0.54 below the normal. Cautionary Signals were displayed during the 6th and 7th, from Cape Henry to Cape Hatteras. A wind-velocity of 40 NW. was reported from the first-named station.

No. V.—first appeared the morning of the 7th, in Nebraska. and moving rapidly eastward, was central in Iowa at midnight; Des Moines barometer 0.18 below the normal. It moved thence with great rapidity and diminishing pressure to Georgian Bay; Parry Sound barometer a. m. of the 8th, 0.33 below the normal; it then followed an eastern course to the Atlantic ocean, and was south of Newfoundland on the morning of the 9th. Its centre was followed by strong westerly gales, with snow in the Lake region. Signals were displayed in the Lower Lake region from midnight of the 6th to midnight of the 7th and were fully justified: Erie SW. 28 miles and Rochester W. 31.

No. VI.—apparently developed in Manitoba during the 10th, and moving southeastward, was in Minnesota the morning of the 11th. Moving eastwardly with diminishing pressure, it was in Ontario at midnight of the 12th; Saugeen barometer 0.49 below the normal. It passed thence northeastward through the Canadian Maritime Provinces to the Gulf of St. Lawrence. Cautionary Signals were ordered for all the lakes except Ontario, but were not justified, although velocities above 20 miles were reported from nearly every station.

No. VII—was apparently central to the northward of Ft. Buford at midnight of the 12th; moving southeastward with rapidly decreasing pressure, it was central the morning of the 14th over Lake Michigan; Escanaba barometer 0.67 and Grand Haven barometer 0.68 below the normal. It then passed northeastward to the Gulf of St. Lawrence (closely following the path of No. VI) which it reached the morning of the 16th. The pressure remained very low over the Maritime Provinces from the 16th until the 19th; Sydney barometer at p. m. of the latter date 0.74 below the normal, after which the pressure rapidly increased. Cautionary Signals were displayed in the Lower Lake region during the 14th, and were justified by the velocities: Port Huron W. 25; Sandusky SW. 29; Buffalo SW. 30. The signal displayed at Eastport on the 15th was also justified by a velocity of E. 36 miles.

No. VIII.—As area No. VII moved eastward during the 13th and 14th, the pressure over the entire country was considerably below the normal. At midnight of the latter date, the barometer

fell on the Rocky Mountain slope, and an area of slight energy was apparently central in western Nebraska. Moving slowly southeastward, it was in Indian Territory during the 15th. Remaining nearly stationary, it merged the following day, into low-area No. IX, with which it is subsequently described. The lowest pressure noted was 0.46 below the normal at Fort Gibson at midnight of the 15th. No Signals were displayed for this area, but south winds, ranging from 25 to 30 miles, were several times reported from Indianola from the 14th to the 16th.

No. IX.—This area apparently developed over the Pacific ocean northwest of Washington Territory. The pressure fell steadily on the North Pacific coast from nearly normal the morning of the 13th to 0.97 below it at Olympia on the morning of the 15th, and 1.02 below at Umatilla. The passage of this storm was marked by moderate rains in the North Pacific coast region from the 13th to the 15th, with light, southerly winds, which changed to a southwest gale near the mouth of Puget Sound as the area passed eastward. Moving southeastward with increasing pressure, it was central in Utah at midnight, and in Kansas on the morning of the 17th; Leavenworth barometer 0.47 below the normal. Moving nearly eastward, it passed off the North Carolina coast on the morning of the 18th. Cautionary Signals—justified, were displayed on the North Carolina coast during the 17th.

No. X—first appeared off the California coast on the 15th, its passage being marked by strong northwest winds, as reported by ship *Fresno*, 35° N., 126° W., and by heavy SW. gales experienced by the ship *Ella* to the northwestward of the *Fresno* that morning, followed in the evening by heavy WNW. squalls. During the night of the 16th and 17th, the barometer fell rapidly along the middle and southern coasts of California; San Francisco barometer the morning of the 17th, 0.59 below the normal. During the day, the area filled up. During its continuance, strong gales prevailed along the California coast, and at San Diego, one building was unroofed and other damage done.

No. XI—apparently developed over the Gulf of Mexico during the 18th and moving eastward across northern Florida on the 19th, passed northeastward and was central in North Carolina, with decreasing pressure, the afternoon of the 20th; Cape Lookout barometer 29.50 or 0.61 below the normal. Continuing in a northeasterly course it was probably to the southward of Newfoundland at midnight of the 22nd. Cautionary Signals were displayed in the eastern half of the Gulf of Mexico and along the entire Atlantic coast during the 19th and 20th and were continued as Cautionary in New England and Off shore from New York southward during the 21st. These signals were justified save at scattered stations. This storm was unusually severe along the Middle Atlantic coast from New York to Macon. High northeasterly gales with low temperatures and heavy snow or rain made it particularly dangerous. The following are the highest velocities reported: Cedar Keys, NW. 30; Eastport, NE. 30; Cape Lookout, SE. 48; Delaware Breakwater, NE. 48; Cape Henry and Chincoteague, NE. 60; Point Judith, NE. 65.

No. XII.—During the 18th the pressure fell off the North Pacific coast, and at midnight this area was apparently to the westward of Oregon. The track of this storm is uncertain, but it probably moved southeastward in a course nearly parallel with the California coast during the 19th and 20th, and filled up on the morning of the 21st. The lowest pressure reported was on the 20th, from San Francisco, 29.72 or 0.41 below the normal. The ship *Ella*, but a short distance southwestward from San Francisco, experienced at 3 a. m. of the 17th, a light southeast breeze which at 8 p. m. had increased to a violent gale; barometer down to 29.55; at 10 p. m. wind lulled and backed gradually to NW.

No. XIII—appeared, likewise on the Pacific coast during the 22nd; Roseburg barometer at midnight, 0.50 below the normal. Moving southeastward through Utah and Colorado, it entered the Gulf States during the 24th; lowest pressure at midnight 29.99 at Mobile. Central the morning of the 25th in Georgia, it moved northeastward with rapidly decreasing pressure, and was off the North Carolina coast at midnight; Cape Lookout barometer 0.46 below the normal. Following a northeasterly course nearly parallel to the coast with continually decreasing pressure, it was off the Nova Scotia coast at midnight of the 27th; Halifax barometer 29.07 or 0.88 below the normal. Signals were displayed during the 25th and 26th (as off-shore along the North Carolina coast on the latter date) from Smithville to Eastport. The storm was one of unusual violence during the 25th along the New Jersey and North Carolina coasts, and on the 26th along the New England coast. Commencing with strong northeast gales and rain, they soon backed to violent northwesterly gales with heavy snow and low temperatures. Fortunately the wind was off-shore most of the time and but few shipwrecks occurred. At Delaware Breakwater the wind attained a velocity on the 25th of NE. 52 miles, and two vessels were wrecked within the harbor. On the 26th the wind at Thatcher's Island attained the remarkable velocity of 84 miles East. Other high velocities reported were as follows: Cape Hatteras and Kittyhawk, NW. 40; Wood's Holl, NE. 40; New Haven, NE. 48; Cape Henry, NW. 56; Shoreham, NE. 64 and Sandy Hook, NE. 68.

No. XIV—was an unimportant depression which during the 26th and 27th moved from Manitoba eastward to Ontario, too far northward to permit of its course being accurately charted.

No. XV—appeared on the Oregon coast during the 26th; Roseburg barometer the morning of the 27th 0.37 below the normal. Its movement thence was very rapid and though decidedly abnormal, was very similar to that of low area No. XIII of this month and No. XV of December, 1877. Its

centre was apparently that afternoon (27th) in southwestern Idaho, at midnight in Utah and on the following morning in western Texas; Stockton barometer at last report 0.34 below the normal. On the afternoon of the 28th the lowest pressure was in the Rio Grande valley 0.32 below the normal. It moved thence eastward across the Gulf of Mexico and passing over northern Florida, followed, during the 29th, a northeasterly path, nearly parallel with, and at some distance from, the Atlantic coast. The lowest pressure noted on that day was at Cape Lookout, p. m. barometer 0.50 below the normal. Off-shore Signals were displayed on the Texas coast from the 26th to the 29th and Cautionary Signals in the Eastern Gulf and along the Atlantic coast as far north as Delaware Breakwater on the 28th and 29th. Cautionary Signals were also displayed from Cape May northward to Eastport, from the afternoon of the 29th to the morning of the 30th. These signals were fully justified by the following maximum velocities: Macon and Cape Lookout, NW. 32 miles; Pensacola, N. 40: Wood's Holl, NW. 43; Thatcher's Island, W. 42; Indianola, N. 51; Cape May, N. 52.

No. XVI.—During the 30th and 31st the pressure gradually decreased over the Gulf States and at midnight of the 31st the barometer at Punta Rassa was 0.11 below the normal.

INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present REVIEW. No. IV is for the month of *November*, 1880, and Nos. V and VI for *April*, 1879.

Chart No. IV.—A *preliminary* chart, which indicates as well as is at present (January 12th, 1881) possible, the tracks of some of the principal storms over the North Atlantic Ocean and adjacent land-areas during the month of *November*, 1880. Up to the 11th the month was remarkably free from severe storms over the region indicated, but from the 12th onward terrific gales were experienced over the eastern portion of the Atlantic, in connection with areas Nos. IV, V, VI and VII, the more complete notice of which storms is reserved until the publication of chart No. VI for this month.

Chart No. V.—Upon this chart are shown the mean pressure, mean temperature, mean force and prevailing direction of the wind at 7.35 a. m., Washington mean time, (0.43 p. m., Greenwich mean time) for *April*, 1879, over the Northern and at certain stations in the Southern Hemisphere.

Pressure.—High pressures (30.20 in., or 767.1 mm., and above) prevailed only over the Atlantic Ocean, south of the 40th parallel, from near the African coast westward to near the Bermudas; Ponta Delgada 30.20 inches or 767.2 mm.; Bermuda, 30.22 or 767.6 (mean at 12 m. local time); Funchal, 30.27 or 768.9, the last mean being the highest reported during the month. The highest absolute reading reported by co-operating observers occurred at Barnaul, Sibera, on the 8th of the month—30.56 or 776.2. In the *Meteorological Bulletin of the Central Physical Observatory of St. Petersburg*, 30.94 or 785.9 is given as occurring at Irkutsk, Siberia, on the 6th, at 7 a. m. Low pressures (29.80 in., or 756.9 mm., and below) covered Hindostan, the British Isles, the greater part of Europe between the 40th and 60th parallels, the Canadian Maritime Provinces, and Behring's Sea. The lowest means reported were those of Hermannstadt, 29.61 or 752.0; Sitka, Alaska, (nine days only) 29.54 or 750.3. The lowest single pressure reported by a co-operating observer was 28.52 or 724.4 at Halifax, N. S., April 1st. As compared with that of the preceding month, (March, 1879,) the mean pressure over countries in the Northern Hemisphere, represented by international observers, showed a decided decrease. The line of no change ran from northern California on the Pacific coast eastward to Lake Superior, eastward and northward passing between the Faroe Islands, Scotland, to northern Norway, thence southward to the Baltic Sea, southeastward to the Ural Mountains, eastward to the Okhotsk Sea (south of the mouth of the Amoor river), and turning southward crossed central Japan to the Pacific. Northward of this line the pressure increased, the greatest change being reported from Stykkisholm, +0.24 in., or 6.1 mm. Southward of the line the pressure decreased, (except a slight rise over Morocco, the Maderias, Egypt, Asiatic Turkey, Persia, and the regions of the Black and Aral Seas.) In America this decrease—slight on the Pacific coast—was most marked to the eastward, being more than 0.10 inch or 2.5 mm. over the Gulf of Mexico and the southern half of the Mississippi valley. In New England and the Canadian Maritime Provinces the changes exceeded 0.20 in. or 5.1 mm., being —0.34 in. at Halifax, —0.31 at Sydney, Eastport and St. John's, N. F. It is probable that the area of —0.30 inch or 7.6 mm., included the Atlantic Ocean from say 43° to 48° north, and eastward from America to 20° west. The deviations over the Azores were —0.10 inch and over the Bermudas —0.17. In Europe the changes of —0.30, or 7.6 mm., occurred over southern England, the greater part of France, Belgium, Austria, Germany, northern Italy, and Poland in Russia. The most important changes were: Groningen, —0.29 in.; Agram and Greenwich, —0.30; Paris, —0.31; Geneva, Warsaw and Vienna, —0.32; Hamburg, —0.34 and Leipsig, —0.37. In northern Algeria the greatest change was —0.13 at LaCalle. In Asia the decrease was greater than 0.10 in China, northern Hindostan and southern Siberia. The following changes are noted: Zi-ka-wei, 0.15 inch, Pekin, 0.16; Barnaul, 0.18 and Lahore, 0.20.

The *General Barometric Range* during April, 1879, was 2.42 inches, or 61.5 mm., from 30.94 or 785.9 mm., to 28.52 or 724.4, on dates as noted above.

Temperature.—In Spain, Morocco, western Algeria and along the Pacific coast of the United States, the mean temperature was the same or *slightly below* that of the preceding month (March,

1879.) Elsewhere the temperature of the northern hemisphere increased. The greatest increase was in the interior of the continents of North America and Asia. In the first-named country changes greater than 10° F. or 5°.6 C. occurred in Canada, Hudson Bay Territory, and the northern part of the United States, (Lake region, the Missouri and Upper Mississippi valleys.) Greatest changes: Godthaab, +16° F.; Rockliffe and Parry Sound, +20°; Forts Buford and Garry, +24° and York Factory, +29°. In Europe the changes were less than 10° F., except in Austria, Russia and parts of Turkey and Sweden: Haparanda, +12° F.; Hermannstadt, +15°; Constantinople, +17°; Kieff and Moscow, +20°; Kasan, +23°; Krotkowo and Lugan, +24°. Over Asia and adjacent islands the increase in temperature was general, and over far the greater part of the continent was more than 10° F.; greatest changes: Nagasaki, +10°; Roorkee, +17°; Lahore, +18°; Barnaul, +19°; Ekaterinburg, +23°. Lowest means were: Nikolaievsk, on the Amoor, 15°.1 F. or —9.4 C., (10:07 P. M., local mean time) and St. Michael's, Alaska, 14°.2 F. or —9°.9 C. (1:59 A. M. local mean-time.) The temperatures experienced during April, 1879, at the winter quarters of the Vega, 67° 3′ N., 171° 32′ W., were reported by Lieut. Bove as follows: mean —2.°1 F. or —18.°93 C.; maximum, 23.°7 F. or —4.°6 C.; minimum, —36,°4 F. or —38.°0 C.

Winds.—During April, 1879, the winds were most generally from *northwest* to *southwest*: these directions very generally prevailed in Algeria, over the Atlantic Ocean north of the thirty-fifth parallel, in Hindostan, and along the eastern coast of North America. Elsewhere in Asia and America the winds were variable, with the *north* and *south* directions quite frequent in the latter country. In the British Isles, northern Europe (except *southerly* winds in Russia) and the Atlantic Ocean south of the thirty-fifth parallel, *northeasterly* winds prevailed. The strongest winds were over the Atlantic Ocean between 40° and 50° N., and from 10° to 55° W.

Chart No. VI.—Upon this chart are traced the paths of the principal storm areas of the Northern Hemisphere during the month of April, 1879. Six prevailed over the Behring Sea region; six first appeared on the Pacific coast of North America, and subsequently crossed the United States; seven first appeared over British America; four seem to have crossed the North Atlantic from America to Europe, while two, Nos. XXXIV and XXXVI, appear to have originated over the ocean. Of the tracks over Europe, six arrived from the ocean and four, Nos. IX, XX, XXV and XXXIII, appear to have developed either over the Mediterranean or in Algeria. Three of the European storms can be traced far into Asia, one of which appears to have reached the mouth of the Amoor. Of the nine storms along the eastern coast of Asia, six came from the interior. No. XXVII was the severe typhoon experienced by the German Bark *Fulda*, and the portion of the track from the 17th to the 23rd is principally based upon a valuable extract of the log of this vessel, as given in the "Annalen der Hydrographie und Maritimen Meteorologie, Heft IV, 1880," the official journal of the German Hydrographic Office and German Naval Observatory. The following is a brief summary of the principal features of each storm. No. I, described in the April REVIEW (1879) as area No. IV, traversed the North American Continent from March 31st to April 5th; on the 31st it was near York Factory; barometer, 29.23. As it approached the Atlantic coast it increased in energy, the wind's velocity at Cape May on the 3rd of April reaching NW. 62 miles and the barometer at Sydney, C. B., on the 4th, falling to 29.02. On the 5th it apparently passed to the northward of Newfoundland. No. II prevailed as a moderate storm from March 31st to April 2nd in the Behring's Sea region. No. III.—From March 31st to April 2nd low pressures prevailed in northeastern Hindostan, which were apparently transferred on the 3rd to China and thence eastward during the 5th and 6th towards and over Japan. No. IV developed on the morning of March 30th in North Carolina and was described in the March and April, 1879, REVIEWS. During March 30th and 31st it moved northeastward from North Carolina to Nova Scotia as the most severe and destructive storm of that month and April in North America; during April 1st and 2nd it passed in the same course over the Canadian Maritime Provinces and Newfoundland; moving in an easterly path over the high latitudes of the North Atlantic, on the 6th it arrived upon the coast of Ireland as a very deep depression. After remaining almost stationary during the 7th, central over the British Isles, it on the 8th again moved rapidly eastward over Europe and Asia, and on the 17th apparently reached the mouth of the Amoor, having traversed 210 degrees of longitude, or about 9,000 miles, in 18 days. During the first half of its existence it was attended by extraordinary low pressures; the lowest recorded of the month, over the northern hemisphere, will be found among the following, which indicate the progress of the storm: *March* 30th, Cape Hatteras, N. C., 29.01; 36° N., 72° W., 28.30; 31st, 200 miles S. by E. of Sandy Hook, 28.37; *April* 1st, Halifax, N. S., 28.52; 2d, St. Johns, Newfoundland, 28.93; 4th, Godthaab, Greenland, 29.30; 6th, Stykkisholm, Iceland, 28.88; 7th, St. Ann's Head, Wales, 28.76; 8th, Stuttgart, 29.13; 9th, Vienna, 29.32; 10th, Kieff, 29.32; 11th, Lugan, 29.56; 12th, Kasan, 29.58; 13th, Ekaterinburg, 29.70; 14th, Barnaul, 29.72; 16th, Nertschinsk, 29.34, and on the 17th at Nikolaievsk on the Amoor, 29.54. Along the American coast and over the western portion of the Atlantic Ocean this storm was exceedingly severe, the wind reaching velocities of 78 miles per hour at Cape Henry and 182 on the summit of Mt. Washington, while hurricane winds were experienced southeastward over the ocean, beyond the Bermudas. During the 6th and 7th it was accompanied by severe southwesterly gales at the entrance of the English Channel. No. V moved southward over the eastern slope of the Rocky Mountains during the 30th and 31st of March, and thence during April 1st rapidly eastward

over the Southern States, followed by a severe "norther" on the Texas coast. It has already been described as areas Nos. XVIII of the March and II of the April REVIEWS, in 1879. No. VI is a continuation of area No. XXXVII, March 1879. No. VII passed eastward on the 2d and was near Shanghai at 4 p. m., and Nagasaki at 9:30 p. m., the minimum barometer readings of the month (29.47 and 29.61, respectively) occurring at these hours. The lowest barometer reading during the passage of this area (29.66) occurred at Tokio at 3:30 a. m. of the 3rd. At Nagasaki and Hiroshima, 3.03 and 2.36 inches of rain were measured during the passage of this storm. No. VIII is a continuation of area No. XXVIII (chart VI) for March. No. IX moved eastward over southern Europe from the Gulf of Lyons on the 2d to the neighborhood of the Caspian Sea on the 8th. No. X moved eastward over the United States from Oregon to the South Atlantic States; it was de-described in the April, 1879, REVIEW as area No. V. No. XI moved eastward over Behring's Sea, from the 4th to the 6th, preceded by SE. gales at Unalaska and St. Paul's Island, the barometer falling at the latter station to 29.09 at 9 p. m. of the 4th, and at St. Michæls to 29.34 at 2 p. m. of the 5th. No. XII apparently developed over Hudson's Bay territory during the 6th, and moved slowly eastward, probably over Labrador, the lowest barometer at Moose Factory, Hudson's Bay, occurring early on the morning of the 6th and at St. John's, Newfoundland, at 9 a. m. of the 10th. On the afternoon of the 8th, the wind at Father Point, Quebec, increased to SW. 45 miles. During the 11th, it appears to have moved eastward over the North Atlantic ocean, central north of the 50th parallel, and during the 12th and 13th, to have curved southeastwardly, with increasing energy and rapidly diminishing pressure to the Bay of Biscay. On the 14th, it appeared at the mouth of the English channel as a severe storm (Scilly, 8 a. m., wind NE., force 10 of Beaufort scale), but as it moved thence towards the Baltic its energy gradually decreased. No. XIII is an area of low barometer, which appeared to move in the direction shown on chart, along the southern slope of the Himalays, from the 6th to the 11th, the barometer on the latter day falling to 29.52 at Goalpara. The position of this track indicates in a general way, the area covered by the lowest pressures of the month over Hindostan (as reported from the co-operating stations), and in only one case (Lahore on the 20th, 29.42,) was a lower pressure than 29.52 reported. No. XIV an unimportant area in Hudson's Bay Territory. No. XV, already described as area No. VII in the REVIEW for April, 1879. It crossed the North American continent from the Pacific to the Atlantic, as a somewhat severe storm, the wind reaching SW., 44 miles per hour at Umatilla, Oregon; SW., 64 on summit of Pike's Peak; NW., 78 at North Platte, Neb., and NE. 56 at Eastport, Me., these being the maximum velocities of the month at the stations named. No. XVI is located over Alaska; on the 7th Unalaska experienced a severe SW. gale, "with fearful gusts from 4 to 9 a. m.;" at St. Paul's the wind backed from E. to N., while at St. Michæl's only a slight barometric fall was experienced. No. XVII was a very similar storm to the preceding, but located a little further north, the centre passing almost directly over St. Paul's Island, at which station the barometer reached at 9 p. m. of the 9th, 28.61, the minimum reading of the month; at St. Michæl's, the barometer fell to 29.08 on the morning of the 10th and during the day severe northerly winds prevailed over Behrings sea (St. Paul's, N. 52 miles). No. XVIII. moved in an east-northeasterly path at some distance to the south of Japan during the 9th and 10th, the lowest pressure occurring at Nagasaki and Hiroshima at 3:30 p. m. of the 9th, and at Tokio at 3:30 p. m. of the 10th. No. XIX, a storm somewhat similar to No. X, although not attended by such high winds, crossed the United States from the Pacific to the Atlantic; it was described in the April Review as area No. VIII. No.XX, during the first portion of its course moved slowly eastward over southern Europe, but on the 13th, when the pressure at centre (Vienna 29.13) was very low, it curved towards the northeast, and by the 19th reached central Siberia. No. XXI, an unimportant area, moved from Manitoba over the Lake region, and was noticed in the April REVIEW as area No. IX. No. XXII. a large area of low barometer, which apparently moved eastward over the North Atlantic from the 16th to the 19th, and over northwestern Europe to the Baltic by the 23rd. No. XXIII moved eastward over the United States, from Washington Territory on the 13th to North Carolina on the 17th, and is described in the April Review as area No. X. As it approached the Atlantic sea-board it increased in severity, and during the 18th and 19th passed in a northeasterly course, central at some distance off the coast as quite a severe storm. Easterly gales prevailed along the coast from New Jersey to Nova Scotia, the highest recorded wind NE. 54, being reported from Boston. This area appears to have crossed the Atlantic as an extensive depression and to have arrived over the British Isles on the 23rd. No. XXIV, like XVIII, moved northeastward off the coasts of China and Japan during the 14th and 15th, the lowest pressures occurring at Shanghai at 5 p. m. of the 14th, at Nagasaki at 3:30 p. m., and Hiroshima at 9:30 p. m. of the 15th, and at Tokio (29.45 the minimum of the month) at 3:30 a. m. of the 16th; at the latter place it was accompanied by the heaviest rain fall (1.51 inches) of the month. No. XXV.—As compared with the other storms of this month, the present track is peculiar, in that it moved in a northerly path from Algeria to Lapland from the 16th to the 21st. No. XXVI passed over the Aleutian Islands during the 17th, the observer at Unalaska reporting "a fearful snow storm all day." At St. Paul's, at 9 p. m., the barometer read 29.37, while the wind was E. 65 miles. This area appears to have passed off in a southeasterly direction, it being hardly felt in St. Michael's, while on the 20th, S. S. Gaelic in 45° N., 162° W., reported barometer 29.48, wind W., force 6, squally. No. XXVII is the approximate path

of the typhoon encountered by the German bark *Fulda*. This vessel, on the 16th, in 10° N., 132° W., had barometer 29.75, with SW'ly winds, which latter prevailed, with increasing energy and gradually decreasing pressure until the 18th, when she crossed the track of the typhoon, the lowest barometer 28.76, occurring at noon in 14° N., 132° W.; after this, the vessel apparently kept to the eastward of the centre. On the 23rd, the storm curved towards the northeast and passed, during the 24th and 25th eastward to the south of Japan, the minimum barometric reading at Tokio, (29.67,) occurring at 3:30 p. m. of the latter date. Nos. XXVIII and XXX were described in the April REVIEW as areas No. XII and XIII. They entered the United States from the Pacific Ocean on the 17th and 19th, respectively, and having moved eastward to the eastern slope of the Rocky Mountains united on the 22nd, formed one area of low pressure, which, being opposed by high barometer to the east of the Mississippi, afterwards moved northeastwards towards Hudson's Bay, the lowest pressure at Moose Factory occurring on the morning of the 25th. No. XXIX moved from the interior of China to Japan, from the 18th to the 20th, the lowest barometer at Pekin (29.72) occurring about 8:15 p. m. of the 18th; at Vladivostock (29.63) about 9:30 p. m. of the 19th, with wind SE. 45 miles per hour, and at Tokio (29.46) at 3:30 a. m. of the 20th. Heavy rains fell at Nagasaki (1.42) and Tokio (1.11 inches.) No. XXXI passed eastward over Behring's Sea on the 22nd and 23rd, the lowest barometer at St. Paul's (29.63) occurring at 9 p. m. of the former, and at St. Michael's (29.48) at 1 a. m. of the latter date. It was accompanied by severe southerly gales, the wind at St. Paul's attaining a velocity of SW. 40, and at St. Michael's SW. 78 miles per hour; at Unalaska southerly winds and high temperatures continued from the 22nd to the 27th. No. XXXII, probably a branch of No. XXVII, moved northeastward during the 23rd and 24th, over the Sea of Japan. No. XXXIII developed over southern Europe on the 23rd in the south quadrant of area No. XXII and moved northeastwardly into central Siberia by the 29th; it was attended by heavy rains in southwestern Europe. No. XXXIV apparently originated over the Atlantic on the 23rd in the extensive depression left by area No. XXIII and passed slowly eastward, accompanied by strong westerly gales on its southern margin; on the 26th it moved southeastward to France and thence over central Europe as a well-marked storm. No. XXXV is described in the April REVIEW as area No. XV. No. XXXVI.—From the 23rd to the 26th very stormy weather prevailed to the south of Nova Scotia and Newfoundland, and an area of low barometer appears to have moved thence northeastward towards Iceland during the succeeding days of April. No. XXXVII moved eastward over the northern half of the United States from the 28th to the 30th and, has already been described as area No. XVI of the April REVIEW.

TEMPERATURE OF THE AIR.

The mean temperature of the air for December, 1880, is indicated by isotherms (in red) on chart No. II. The table of temperatures on that chart shows (as deduced from Signal Service observations of the past nine years) the mean temperatures for the various districts, and the departures from such means during December, 1880. As will be observed from that table, the mean in every district east of the Rocky Mountains has been below the normal. Over the country to the westward, the temperature has been slightly above the normal, except at Portland, Oregon, where a deficiency of 2°.2 prevailed. The temperature has been deficient 5° or more over the entire Missouri, Ohio and Upper Mississippi valleys, the Lake region (except northeastern New York), the Middle States, Tennessee and North Carolina. From the Upper Missouri valley deficiencies are reported, ranging from 10.5° at Bismarck to 13°.5 at Ft. Buford and 18° at Ft. Shaw. During the past ten years, lower *mean* temperatures, during December occurred generally east of the Missouri valley in 1872 and 1876—also in 1878 over the Gulf States and in 1879, over the Missouri valley. At Baltimore and Washington alone, have the lowest mean temperatures of the past decade occurred. The following deviations at detached stations not included in the districts, are noted: Mount Washington, —0°.3; Pike's Peak, +1°.5; Key West, —2°.9; Punta Rassa, —2°.0. The following are extracts from reports of voluntary observers: *Kansas:* Lawrence, mean 3°.05 below that of past twelve years. Holton, month unusually cold. *Maine:* Gardiner, month remarkable not for its extreme cold but for its uniformity of temperature; mean temperature for past 45 years, 22°.10, for December, 1880, 0°.25 below. *Maryland:* Fallston, mean lowest in past ten years, except December, 1876. *Nebraska:* Genoa, month very cold. *New Hampshire:* Lake Village, Lake Winnepiseogee closed by ice on the 24th; one to two weeks earlier than usual. Contoocookville, mean 2° below that of ten years. *New Jersey:* Newark, mean 7°.2 below the average of 35 years; the last decade of the month lower by 12° than such average. *New York:* North Volney, mean 4.85° below that of December for past ten years. Friendship, coldest weather for years. Hector, month unusually cold. *Ohio:* Hudson, month remarkably cold. *Pennsylvania:* Wellsboro, mean lowest for past ten years; during the last four days of the month the temperature ranged lower than in any preceding December for twenty years. *Virginia:* Dover Mines, mean 13°.1 lower than in 1879. Wytheville, month very cold. *West Virginia:* Helvetia, coldest in five years. Wellsburg, coldest for many years.

Maximum and Minimum Temperatures.—Maximum temperatures exceeding 80°, have occurred only in the interior of Texas and at Key West; under 40° only in Minnesota and the Lake Superior region. The lowest maximum 36°, was observed at Duluth on the 14th and the highest, 87° at Key West on the 18th. The temperature of 58° was noted at Ft. Benton on the 11th, and of 60° at Ft.

Keogh on the 12th.. The minimum temperatures reported from Signal Service Stations for December, 1880, were remarkably low. They were at many stations the lowest on record, and as a whole, were the most remarkable since 1835 throughout the whole country east of the Rocky Mountains, except in New England. The zero isotherm of minimum temperatures, quitting the New Jersey coast north of Cape May, ran southwestward through eastern Virginia to the northeastern part of South Carolina, thence nearly due west to Fort Sill in Indian Territory, and southwestward to the valley of the Rio Grande in Texas, and following that valley up its full extent, reached the northern boundary of the United States along the western edge of the Rocky Mountain range. The isotherm of minimum temperatures of —20° ran southward along the western shore of Lake Michigan to Milwaukee, westward to Yankton, and after a southward curve, which included North Platte and Cheyenne, followed the Rocky Mountain range to the British possessions. Temperatures of —40° and below, occurred as follows: Ft. Benton, 29th, —59°, 30th, —56°; Ft. Garry, 27th, —40°, 28th, —44°; Ft. Custer and St. Vincent, 28th, —42°; Ft. Assiniboine, 29th, —42°; Ft. Shaw, 29th, —42°; 30th, —40°; Helena, 30th, —40°; Ft. Stevenson (medical department), 28th, —45° (Signal Service —26°). Minimum temperatures of the month exceeding 28°, were reported only from California and southern Florida. The following comparisons and notes are of interest: Washington, D. C., —13°, the lowest on record in Dec., being 3° below that of 1835. *Alabama:* Mobile, 30th, 14°, lowest since Signal station was opened, (1871;) many domestic animals killed by cold. Montgomery, 30th, 8°, lowest since Signal station was opened, (1871.) *Florida:* Pensacola, 30th, coldest weather ever remembered. Jacksonville, 30th, coldest weather since 1857; 19^{d}; oranges on the trees in the city frozen. *Georgia:* Gainesville, —4°, coldest since 1835. Forsyth, 30th, 4°, lowest in middle Georgia since February 8th, 1835. Minimum temperatures at Eatonton —3° and at Milledgeville —8°. Atlanta, 30th, 1° (Department of Agriculture —1°), said to be the coldest for 25 years. Augusta, 30th, 7°, coldest since Signal station was opened (1871), and probably for 25 years; next coldest, January 19th, 1873. 15°. Columbus, 4°; on Alabama Hills, zero, coldest on record. *Kansas:* Independence, 29th, coldest ever known. *Maryland:* Fallston, —12°, lowest on record (16 past years); at Hollingsworth Mills, 290 feet lower, —21°, on the morning of the 31st. Cumberland, —10°, lowest temperature on record (nine preceding years). Sandy Springs, coldest ever experienced; near Pikesville it reached —20°, at Ellicott City —21°, and at Ryder's Station —24°. Baltimore, 30th, coldest since 1874. *Michigan:* Alpena, lowest December temperature since station was opened, (1873.) Coldwater, city thermometer registered —27°. Thornville, coldest for many years. *Missouri:* The Missouri Weather Service says: "The lowest temperature in the State was at Sedalia, —24°." St. Louis, 29th, —15°, coldest in office (Signal Service) records. *New Hampshire:* Contoocookville, —8°; temperatures ranging from —20° to —23° reported from other parts of the village. *New Jersey:* Newark, 30th, —6°.5, coldest in a record covering past 37 years, except in December, 1851, when it was —7°.5; minimum reported by another observer, —11° on the 31st. Freehold, coldest day in many years. Linden, lowest temperature in many years. *New Mexico:* Silver City, 31st, —7°, coldest ever known. *New York:* White Plains —14°; in 1865, —18°. *North Carolina:* Lenoir, 30th, coldest ever known. Weldon, 31st, —5° coldest on record, (10 years.) Portsmouth, 30th, 15°, coldest for many years. *Pennsylvania:* Dyberry, minimum —19°; 30th, mean temperature —4°.8, coldest since January 8th, 1866, when the mean was —12°.0. Pittsburg, 30th, —9°, lowest December temperature ever recorded. *South Carolina:* Aiken, 3°, lowest ever recorded; next coldest, 10°, December, 1870. Charleston, 30th, coldest since opening of station (1871); city records do not show so low a temperature since 1835. *Tennessee:* Memphis, 29th, 3°, coldest on record, except Dec. 2nd and Jan. 6th, 1875, when the same temperature was recorded. Knoxville, 30th, —5°, lowest since 1877. Chattanooga, 30th, —3°. *Texas:* Melissa, 29th, —6°, coldest in many years. Corpus Christi, 19°, coldest in many years. San Antonio, 29th, 10°, coldest ever known. Indianola, 29th, 14°, coldest ever known. *Virginia:* Dover Mines, 31st, —16°, coldest ever known. Dover, Loudon county, 31st, —34°, lowest ever known. Accotink, —15°; in valley to east of station and 100 feet lower, —28°. Wytheville, —10°, coldest since 1868, when the same temperature was recorded. Richmond, —8° at sunrise. Cape Henry, 29th, coldest day since 1857. Danville, 30th, —12°, coldest ever known. Lynchburg, zero, lowest since station opened in 1872. *West Virginia:* Helvetia, 30th, —13°; on hill 200 feet higher, —16°.

The following are the maximum and minimum temperatures reported in each State and Territory:

Maximum Temperatures.—Alabama: 77° at Mobile and Montgomery. *Arizona:* 80° at Tucson. *Arkansas:* 74° at Little Rock and *Mt. Ida. *California:* 80° at Los Angeles. *Colorado:* 65° at *Trinidad and 61° at Denver. *Connecticut:* 50° at New Haven and New London. *Dakota:* 58° at Deadwood. *Delaware:* 60° at Delaware Breakwater. *District of Columbia:* 54° at Washington. *Florida:* 87° at Key West. *Georgia:* 79° at *Thomasville and 77° at Savannah and Augusta. *Iowa:* 55° at Keokuk. *Idaho:* 52° at Boise City. *Illinois:* 69° at Cairo. *Indiana:* 59° at *New Harmony and 56° at Indianapolis. *Indian Territory:* 77° at Ft. Sill. *Kansas:* 68° at *Emporia and 62° at Dodge City. *Kentucky:* 63° at Louisville. *Louisiana:* 80° at *Lake Charles and 78° at New Orleans. *Maine:* 46° at *Gardiner and 44° at Portland. *Maryland:* 59° at *Deer Park and 56° at Baltimore. *Massachusetts:* 51° at Wood's Holl. *Michigan:* 50° at Port Huron and Alpena. *Minnesota:* 40° at Minneapolis and 38° at St. Paul. *Mississippi:* 78° at Vicksburg. *Missouri:* 64° at St. Louis, *Pierce City and *Warrenton. *Montana:* 60° at Ft. Custer. *Nebraska:* 65° at *Ft. Niobrara and 58° at

North Platte. *Nevada:* 55° at Pioche. *New Hampshire:* 42° at *Contoocookville and 31° on summit of Mount Washington. *New Jersey:* 55° at Cape May. *New Mexico:* 72° at La Mesilla. *New York:* 56° at *Ft. Niagara and 53° at Rochester. *North Carolina:* 77° at Wilmington. *Ohio:* 66° at *Portsmouth and 60° at Cleveland and Cincinnati. *Oregon:* 65° at Roseburg. *Pennsylvania:* 69° at Pittsburgh. *Rhode Island:* 50° at Newport. *South Carolina:* 73° at Charleston. *Tennessee:* 71° at Memphis. *Texas:* 94° at *Ft. Ringgold and 88° at Rio Grande City. *Utah:* 49° at Salt Lake City. *Vermont:* 43° at *Windsor and *Woodstock, and 41° at Burlington. *Virginia:* 71° at Cape Henry. *Washington Territory:* 60° at *Bainbridge Island and 51° at Olympia. *West Virginia:* 67° at Morgantown. *Wisconsin:* 44° at Milwaukee. *Wyoming:* 60° at Cheyenne.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Minimum Temperatures.—Alabama: 4° at *Green Springs and 8° at Montgomery. *Arizona:* 11° at Apache and Prescott. *Arkansas:* 0° at *Mt. Ida and 6° at Little Rock. *California:* 25° at Campo. *Colorado:* 21° at *Ft. Collins and —15° on summit of Pike's Peak. *Connecticut:* —10° at *Mystic and —4° at New Haven. *Dakota:* —45° at *Ft. Stevenson and —38° at Ft. Buford. *Delaware:* 1° at Delaware Breakwater. *District of Columbia:* —13° at Washington; *Distributing Reservoir, —15°. *Florida:* 17° at Pensacola. *Georgia:* —8° at *Milledgeville and 1° at Atlanta. *Iowa:* —25° at *Cresco and —19° at Dubuque. *Idaho:* 8° at *Ft. Hall and 19° at Boise City. *Illinois:* —25° at *Sterling and —19° at Champaign. *Indiana:* —19° at *Wabash and —18° at Logansport. *Indian Territory:* —3° at Ft. Gibson. *Kansas:* —22° at *Topeka and —14° at Leavenworth and Dodge City. *Kentucky:* —7° at Louisville. *Louisiana:* 10° at Shreveport. *Maine:* —11° at *Gardiner and —1° at Portland. *Maryland:* —19° at *Emmittsburg and —3° at Baltimore. *Massachusetts:* —10° at *Rowe and *South Lee, and —7° at Thatcher's Island. *Michigan:* —23° at Escanaba. *Minnesota:* —42° at St. Vincent. *Mississippi:* 11° at *Fayette and 12° at Vicksburg. *Missouri:* —24° at *Sedalia and —15° at St. Louis. *Montana:* —59° at Ft. Benton. *Nebraska:* —26° at North Platte. *Nevada:* 12° at Pioche. *New Hampshire:* —28° on summit of Mt. Washington and —10° at *Grafton. *New Jersey:* —18° at *Linden and —7° at Atlantic City and Barnegat. *New Mexico:* —4° at* Ft. Union and —3° at Santa Fe. *New York:* —30° at *Madison Barracks and —9° at Buffalo. *North Carolina:* —16° at *Lenoir and —5° at Charlotte. *Ohio:* —16° at *Westerville and *Jacksonburg, and —13° at Sandusky. *Oregon:* 18° at *Eola and 19° at Portland. *Pennsylvania:* —19° at *Dyberry and —9° at Pittsburg. *Rhode Island:* 2° at Newport. *South Carolina:* 3° at *Aiken and 13° at Charleston. *Tennessee:* —5° at Knoxville. *Texas:* —3° at Ft. Elliott. *Utah:* 15° at *Ft. Douglass and 17° at Salt Lake City. *Vermont:* —19° at *Woodstock and —7° at Burlington. *Virginia:* —34° at *Dover and —11° at Ft. Whipple. *Washington Territory:* 20° at Olympia. *West Virginia:* —21° at *Flemington and —9° at Morgantown. *Wisconsin:* —35° at *Embarrass and —25° at La Crosse. *Wyoming:* —31° at *Ft Washakie and —24° at Cheyenne.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Ranges of Temperature at Signal Service Stations.—Monthly Ranges, in general varied from 57° to 75° over the country east of the Rocky Mountains. Ranges less than 50° occurred only in New England, southern Florida and on the Pacific slope. The smallest ranges were: San Francisco, 19°, on the Pacific slope; Key West, 31°; Eastport and Punta Rassa, 42°, east of the Rocky Mountains. Ranges exceeding 80° were: Cheyenne, Ft. Buford and North Platte, 84°; Ft. Elliott, Tex., 86°; Helena, 91°; Ft. Assinboine, 95°; Ft. Shaw, 96°; Ft. Custer, 102° and Ft. Benton, 117°. The *daily ranges* varied *generally* as follows: in New York, New England and the Middle States from 19° to 24°; in the South Atlantic and Gulf States (except northwestern Texas) and in Tennessee from 24° to 31°, in the remaining districts east of the Rocky Mountains from 32° to 42°; on the Pacific coast from 13° to 22°. The *largest ranges* were North Platte, 53°; Fort Davis, 52°; Keokuk and Milwaukee, 47°, Cheyenne, Campo, St. Louis and La Crosse, 46°. The *smallest*, San Francisco and Sacramento, 13°; Brownsville, Tex., 17°; Oswego, 18°; Key West, Wood's Holl, Cape May, Thatcher's Island and New Shoreham, 19°.

Frost.—Frosts were unusually frequent and severe. Those in the Gulf States from the 9th to the 12th and from the 25th to the 31st, were exceedingly severe, that of the end of the month injuring vegetation in Texas even to the mouth of the Rio Grande and on the Florida coast to near Punta Rassa. The only sections *not* visited by frost were southern Florida and the extreme southwestern portion of Arizona; certain sheltered stations in southern California also escaped it.

PRECIPITATION.

The general distribution of rainfall (including melted snow) for December, 1880, is shown on chart No. III, from the reports of over 500 stations. The table on that chart shows the precipitation for the present month as compared with the *average*. The region of greatest rainfall included the Pacific slope northward of central California; on the Atlantic slope the rainfall was heaviest along the coast of New Jersey, Delaware and Virginia. In New England the rainfall continued deficient, except in Maine and Connecticut. The excess in the Middle States was very marked on the coast and gradually diminished towards the interior. In the South Atlantic States the rainfall was especially local. The departures from the means at various stations being: Jacksonville, —1.90 inches; Charleston, —2.48; Cape Lookout, —5.04; Kittyhawk, +0.93; Charleston, +4.52. In the Gulf

States the deficiency was general (except an excess in eastern Alabama) and well distributed, with the peculiarity, however, of an excess of 1.67 at New Orleans; over eastern Texas and western Louisiana the departures ranged from —2.83 inches at Shreveport to —3.50 at Indianola and —3.60 at Corsicana. In the Ohio valley and Tennessee the deficiency was general, with an excess at one station (Cincinnati) of 0.51 inch. In the Lake region the greatest deficiencies occurred in the neighborhood of Lake Erie and the southwest part of Lake Michigan. The deficiencies in the Upper Mississippi and Lower Missouri valleys were well distributed. Over the region of least rainfall, Kansas and Nebraska, probably not more than one-quarter of the usual amount fell. The excess on the Pacific slope amounted at San Diego to 1.80, at San Francisco to 7.64 and at Portland, Or., to 7.69 inches. At Bainbridge Island, Wash. Ter., the month's rainfall was the greatest ever recorded, (twenty years record) being 17.25 inches, which is 3.55 in. larger than that of March, 1875.

Special Heavy Rains.—1st, Chattanooga, 3.08 inches in the 15 hrs. preceding 5:20 a. m. 1st and 2nd, Elsworth, N. C., 5.00; Murphy, N. C., 3.00; San Francisco, 2.72; Red Bluff, 2.01; Sacramento, 2.97. 2nd and 3rd, Mt. St. Helena, Cal., 6.65. 3rd, San Gorgonio, Cal., 2.61 in 17 hrs. 4th, Vevay, Ind., 3.75 in 16 hrs. 4th and 5th, Lenoir, N. C., 2.00; Cincinnati, 3.27 (voluntary observer); Murphy, N. C., 1.80; Cincinnati, 3.17, of which 2.21 fell in eight hrs.; Louisville, 2.83, of which 1.68 fell in eight hrs.; Flemington, W. Va., 2.05 in 13 hrs. 5th, Elsworth, N. C., 2.00; Marietta, Ohio, 2.10. 5th and 6th, Green Springs, Ala., 2.56. 6th, Savannah, 2.80 in eight hrs. 7th, New Westminster, B. C., 4.01. 10th, Portland, Or., 1.78 in 16 hrs. 14th and 15th, San Francisco, 2.17. 15th, Los Angeles, 2.26. 15th and 16th, Mt. Washington, 2.56. 15th to 17th, San Gorgonia, Cal., 6.18 in 63 hrs. 16th and 17th, Savannah, 3.49. 17th, New Orleans, 2.00 in two hrs. and five minutes. 18th and 19th, Princetown, Cal., 1.79. 19th, Cedar Keys, 3.28 in six hrs. and 35 min. 19th and 20th, San Francisco, 2.46; Red Bluff, 2.93; Sacramento, 2.60; Mt. St. Helena, Cal., 5.73; Colusa, Cal., 3.17. 20th, Wilmington, 1.65. 20th and 21st, Elsworth, N. C., 2.85; Chincoteague, Va., 2.36; Kittyhawk, 3.50, of which 1.77 fell in eight hrs. 21st, Brookhaven, N. Y., 2.47; Atlantic City, 2.01, of which 1.63 fell in eight hrs. 23rd and 24th, Mt. St. Helena, Cal., 9.04. 24th and 25th, Red Bluff, 2.57; Sacramento, 2.03. 25th–30th, Ft. Stevens, Or., 9.45, of which 6.25 fell in 72 hours. 25th, Elsworth, N. C., 3.50. 26th, Cape Henry, 1.92. 28th and 29th, Murphy, N. C., 2.30. 29th, Brookhaven, N. Y., 2.00.

Largest Monthly Rain-falls on the Pacific coast.—*California*: Mount St. Helena, 28.91; Redding, 18.39; Colfax, 16.47; Cisco, 16.33; Calistoga, 15.83; Emigrant Gap, 15.38; Ft. Gaston, 14.77; Tennant, 14.43; Auburn, 13.91; Alta, 13.80; Red Bluff, 12.85; Santa Cruz, 12.59; Oakland, 12.57; San Francisco and Gilroy, 12.33; Angel Island, 12.06; Sacramento, 11.81; Alcatraz, 11.80; San Mateo, 11.37; Suisan, 10.80; South Vallejo, 10.71; Pleasanton, 10.61; Oroville, 10.59; Davis, 10.47; San Gorgonio, 10.27; Dunnigan, 10.23. *Washington Ty.*: Neah Bay, 23.22; Bainbridge Island, 17.25; Olympia, 16.66; Ft. Canby, 13.54; *Oregon:* Ft. Stevens, 21.27; Portland, 13.93; Eola, 11.50; Albany, 10.00. *British Columbia:* New Westminster, 12.12 (25 days); Victoria, 11.98. Elsewhere they were: Ellsworth, N. C., 13.00; Cape May, 9.21; Green Springs, Ala., 8.28; Barnegat, 8.20; Forsyth, Ga., 7.61; Brookhaven, N. Y., 7.56; Vineland, N. J., 7.52. The *smallest* were: Fort Collins, Col., 0.01; Fort Wallace, Kan., 0.02; Dodge City, 0.03; Trinidad, Col., 0.10; Edinburg, 0.11; Wellington, Kan., 0.14; Yates Centre, Kan., 0.19; Emporia, Kan., 0.21.

Rainy Days.—Rain (or melted snow) to the amount of 0.01 inch has fallen on an unusual number of days in the country at large. Such days generally numbered from 18 to 22 in the Lake region and Ohio valley; elsewhere from the Mississippi valley eastward from 12 to 18. On the Pacific coast from 10 to 14 in southern California, and 20 to 24 elsewhere. The stations reporting the smallest number of such days were Denver, Dodge City and Yuma, 2; Eagle Pass and Cheyenne, 4.

Cloudy Days.—The month has been marked by extreme cloudiness from the Mississippi valley eastward. The number of such days has generally varied in the Atlantic and Gulf States from 10 to 14; in Tennessee, the Ohio and Upper Mississippi valleys, from 14 to 18, and in the Lake region from 20 to 25. Regarding this, the following extracts from Signal Service Observers are noted: Little Rock, 2d, "sun seen for the first time since November 23d." Chicago, 27th, "sun first seen since the 14th." Detroit, 27th, "unbroken cloudiness since the 11th." Cleveland, 24th, "unbroken cloudiness since the 15th." Springfield, Ill., 24th, "eighth day without sunshine." Wellsboro, Pa., general cloudiness prevailed for 26 days—largest number reported. Buffalo, Oswego and Rochester each report 25 cloudy days. From Denver but one and from Yuma but two cloudy days were reported. On the Pacific slope from San Francisco northwards cloudiness prevailed from 20 to 25 days.

Rain or Snow from a Cloudless Sky.—Oregon, Mo., 12th; Cincinnati, 10th; Burlington, Vt., 10th; Springfield, Ill., 29th; Bangor, Me., 29th.

Snow—has fallen almost daily from the 6th, in New England, the Lake region and Upper Mississippi valley, and from the 18th in the Ohio and Missouri valleys and the Middle States; on the 20th, 21st, 26th and 29th, in the South Atlantic States; on the 19th, 20th, 22d, 28th, 29th and 31st, in the Gulf States; from the 2d to 5th, 8th, 24th, 28th and 29th, North Pacific region. The snowfall in the northwest districts though frequent was much lighter than usual. In the Atlantic States from

Connecticut to the northern half of North Carolina the snowfall was unusually large, ranging from two to three feet. The following special cases are noted: 28th, Green Springs, Ala., seven inches; Okalooska, La., one inch. 29th, Forsyth, Ga., four inches, heaviest fall since 1856; Atlanta, "one of the heaviest ever known;" Mobile; Montgomery, "five inches, very remarkable, heaviest ever known;" Columbus, Ga., 4½ inches, "heaviest on record;" Augusta, Ga., "heaviest fall since 1857." 30th, New Orleans; El Paso, Tex.; Rockport, Tex.; three inches. 31st, Brownsville, Tex.; Fort Ringgold, Tex., two inches; Rio Grande City, 1.7 inches, first snow since December, 1866.

Greatest Monthly Snow-falls.—California: Summit, 62 inches; Truckee, 80; Emigrant Gap, 114; Cisco, 120. *Nevada:* Reno, Battle Mountain and Toano, 12; Winnemucca, 18. *Utah:* Blue Creek, Terrace and Corinne, 18. *Connecticut:* Mystic, 31. *Delaware:* Dover, 35. *Maryland:* Sandy Springs, most for 20 years; Deer Park, 35; Cumberland, 22. *Massachusetts:* Rowe and Somerset, 24; Fall River, 21. *Michigan:* Niles, 44. *New Hampshire:* Grafton, 28. *New Jersey:* Atco, 33; Freehold, 51; Vineland, 39. *North Carolina:* Highlands, 17. *Ohio:* College Hill, 24; North Lewisburg, 18. *Pennsylvania:* Philadelphia, 22; Fallsington, 21. *Virginia:* Dover Mines, 18; Mt. Solon, 28; Dover, 24.

Snow on Ground at End of Month—was reported from every station in New England, Middle States, Lake region, Tennessee, the Ohio, Missouri and Upper Mississippi valleys, in quantities generally ranging from 1 to 8 inches. The following special cases are noted: Brackettville and Rio Grande City, Tex., trace; El Paso and Brownsville Tex., 1 inch. Vicksburg, Miss. and Augusta, Ga., ½ inch. Atlanta, Montgomery and Ft. Davis, Tex., 2. Charlotte, N. C., 8. Washington, 14. Helena, M. T., 23. Oswego, 24.

RELATIVE HUMIDITY.

The relative humidity, not corrected for elevation, in the Atlantic and Gulf States, Tennessee, the Mississippi, Ohio and Lower Missouri valleys has generally ranged from 70 to 75 per cent; in the Lake region from 76 to 83 per cent.; in northern California from 81 to 88 per cent.; in the Plateau district from 56 to 78 and Rocky Mountain districts from 49 to 63. The following percentages are noted as of interest: Cheyenne, 49; Pikes Peak, 61; Mt. Washington, 79; Indianola, 81; Cleveland, Escanaba and Grand Haven, 83; Duluth and Sacramento, 88; Bismarck, 89; St. Vincent, 91 and Chincoteague, 93.

WINDS.

The prevailing winds during December, 1880, at Signal Service stations are shown on chart No. II, by arrows which fly with the wind. *Northwesterly* winds have prevailed in New England, Tennessee, the Middle and Gulf States and from the Mississippi valley westward to the Rocky Mountains. In the Lake region and the Ohio valley the winds were *southwesterly*. In other districts they were *variable*.

Total Movements.—The following were the *largest* in the *various* districts: Mt. Washington, 20.469 miles; Pike's Peak, 19.940; Cape May, 15.577; New Shoreham, 14.727; Sandy Hook, 13.665; Delaware Breakwater, 13.468; Thatcher's Island, 13.031; Cape Lookout, 12.637; Indianola, 11.361; Eastport, 10.393; Sandusky, 9.985; Milwaukee, 9.603. The *smallest* were: Phœnix, Ariz., 1.269 miles; La Mesilla, N. M., 1.532; Roseburg, Oregon, 2.127; Helena, Mont., 2.248; Visalia, Cal., 22.69; Augusta, Ga., 2.667; Lynchburg, 2.758; Castroville, Tex., 2.783; Deadwood, 3.072; Dubuque, 3.312; Boise City, 3.318.

High Winds.—Winds of 50 miles and above were observed as follows: on Mt. Washington from 1st to 7th, 10th, 12th to 17th, 26th to 28th, 30th, 31st; the highest wind was NW. 99 miles on the 30th and from other points S. 80 on the 5th and E. 70 on 26th; on Pikes Peak, from 1st to 7th, 12th to 14th, 23rd to 27th, with a maximum of NW. 78 on the 6th; Fort Benton, W. 50 on the 12th; Portsmouth, SE. 50 on the 20th; Kittyhawk, NE. 50 on the 9th: Indianola, N. 51 28th and 29th; Cape May, NW. 52 on the 30th; Milwaukee, SW. 53 on the 5th; Yankton, NW. 56 on the 5th; Chincoteague, NE. 60 on the 20th; Cape Henry, NE. and NW. 60 on the 20th and 28th respectively; Barnegat, NE. 62 on the 26th; New Shoreham, NE. 64 on the 26th; Thatcher's Island, E. 84 on the 26th.

Local Storms.—The following tornadoes on the 4th were reported by the Missouri Weather Service and the voluntary observers of the Signal Service in that section: Between the hours of 7 and 8 p. m., three comparatively violent tornadoes, pursuing nearly parallel paths to the northeastward, occurred in southwestern Missouri in connection with the passage of low-pressure area No. III. The track of the one farthest north passed near the towns of Sarcoxie, Lawrenceburg and Ash Grove, destroying five buildings and causing much damage to other property. The second storm passing near Pierce City, visited the towns of Verona, Brookline, Springfield and Marshfield. Eleven buildings were either unroofed or torn to pieces and several animals killed, besides which, much other damage was done to fences, haystacks and farm machinery. Width of storm-path about 300 yards. The third storm passed through portions of Barry, Stone, Christain and Webster counties, visiting the town of Ozark. Several buildings were wrecked and considerable damage done.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for December, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 84.9 per cent. The percentages for the four elements are: Weather, 91.0; Direction of the Wind, 83.3; Temperature, 83.4; Barometer, 81.0 per cent. By geographical districts they are: for New England, 86.6; Middle States, 88.7; South Atlantic States, 87.4; Eastern Gulf States, 86.3; Western Gulf States, 82.9; Lower Lake region, 86.5; Upper Lake region, 83.2; Tennessee and the Ohio valley, 84.8; Upper Mississippi valley, 80.3; Lower Missouri valley, 80.4; Northern Pacific coast region, 87.0; Central Pacific coast region, 90.7; Southern Pacific coast region, 92.0. There were 101 omissions to predict out of 3,813 or 2.65 per cent. Of the 3,712 predictions that have been made, 117, or 3.15 per cent. are considered to have entirely failed; 116, or 3.12 per cent. were one-fourth verified; 495, or 13.34 per cent. were one-half verified; 441, or 11.88 per cent. were three-fourths verified; 2,543, or 68.51 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals—215 Cautionary Signals were displayed during the month, of which 182, or 84.7 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of, 100 miles of the station. 103 Off-shore Signals were displayed, of which 94 or 91.3 per cent, were fully justified, 96 or 93.2 per cent, justified as to direction and 95 or 92.2 per cent were justified as to velocity. Sixty-three of the Off-Shore were changed from Cautionary. 318 Signals of both kinds were displayed, of which 276 or 86.8 per cent, were fully justified. The above does not include signals ordered for 49 display stations, where the velocity is only estimated. Thirty-five signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of chart No. III are given the highest and lowest stages of water, as observed on the Signal Service river-gauges, during the month of December, 1880. The Arkansas, Missouri, Mississippi, lower Ohio, Red and Cumberland rivers were at a fair stage of water during the entire month. In the upper Ohio the river fell from the 6th, and on the 29th was at its lowest stage, one foot ten inches above bench-mark at Pittsburgh. In California the Sacramento rose rapidly on the 20th, but no flood occurred.

Ice in Rivers and Harbors.—The following items show the condition of the navigable waters throughout the United States, during the month of December, 1880, in respect to the formation of ice. In general, the upper portions of the Missouri and Mississippi rivers and tributaries, and lakes Superior, Michigan and Huron continued frozen and navigation suspended throughout month; on lakes Erie and Ontario navigation was entirely closed by the 10th, and towards the end of the month the Arkansas and Ohio rivers froze over and ice formed generally along the Atlantic and Gulf coasts. During the first half of the month considerable ice formed in the Frazer and Columbia rivers, which is noted more in detail below. *Missouri River.*—At Fort Benton ice was observed in the river on *November* 16th, and during the night of the 22d the river closed. During the whole of December this river remained closed by ice, from Omaha upward. At Leavenworth floating ice was reported from the 1st to 5th; on the 6th it gorged and the river remained frozen over to end of month, when the ice was thirteen inches thick. *Kansas River.*—Lawrence, Kans., 31st, ice on river 14 inches thick. *Mississippi River.*—From Davenport, Iowa, northward, this river continued frozen throughout the month. Keokuk, Iowa, 1st to 7th, floating ice; 8th, river closed; 11th, breaking up in places; 12th to 31st, open in places. St. Louis, Mo., 8th to 12th and 28th to 31st, navigation suspended by ice in river; 30th, river gorged; 31st, persons crossing river on ice. Cairo, Ill., 27th, river frozen; 30th, people crossing on ice. Memphis, Tenn., 30th and 31st, floating ice. *Des Moines River.*—Boonsboro, Iowa, 31st, ice on river 16 to 18 inches thick. *Grand or Neosho River.*—Fort Gibson, Ind. T., 28th, river frozen over; 29th, ice 5 inches thick. *Arkansas River.*—Little Rock, Ark., 29th, floating ice; 30th, river frozen entirely across, from this place up to Fort Smith, and gorged at Pine Bluff.—*Red River.*—Shreveport, La., floating ice on the 29th and 31st. *Ohio River.*—Pittsburgh, Pa., 29th, river frozen, navigation closed. Wellsburg, W. Va., 1st., ice broke; 3rd, navigation resumed; 29th, river closed by ice; 31st, teams and people crossing. Portsmouth, Ohio, 21st to 29th, floating ice; 29th, during night, frozen over; 30th, people crossing. Cincinnati, Ohio, 25th, ice forming; 29th, river frozen over, navigation suspended. Vevay, Ind., 27th, navigation suspended; 31st river frozen over and people crossing. Louisville, Ky., 28th, navigation closed; canal completely and river partly frozen; 29th, river frozen over. Cairo, Ill., 29th, navigation suspended by floating ice. *Monongahela River.*—Morgantown, W. Va., 10th, river frozen; 14th, ice broke up; 28th, frozen over. *Lake Superior.*—Duluth, Minn., 4th, ice disappeared from lake; 6th, ice formed and navigation closed. Marquette, Mich., 5th, ice moved from around the docks but formed again on the 10th. *Lake Michigan.*—Chicago, lake generally frozen throughout the month; the ice moved away, temporarily, from the docks on the 5th and 14th. *Lake Huron.*—Alpena, Mich., 12th, Thunder Bay full of ice, 3 to 5 inches thick. Port Huron, Mich., 10th, navigation closed; 11th, ice 9 inches thick; 22nd, ice bridge across bay from Port Edwards to Fort Gratiot Lighthouse.

St. Clair River.—Marine City, Mich., 27th, river frozen over; teams crossing. Port Huron, Mich., 27th, river open; 29th to 31st, gorged at mouth of Black River; 30th, ferry-boats making occasional trips to and from the Canadian shore; 31st, navigation suspended. *Lake Erie.*—Toledo, O., 5th, navigation closed. Cleveland, O., 29th. lake frozen as far as visible. Erie, Pa., 3rd, navigation closed. Buffalo, N. Y., 8th, navigation closed. *Niagara River.*—Buffalo, N. Y., 6th, river frozen over; Ft. Niagara, floating ice on the 12th, and from 28th to 31st. *Lake Ontario.*—Charlotte, N. Y., 10th, navigation closed. Oswego, N. Y., 10th, river frozen over below the bridge. *Lake Champlain.*—Burlington, Vt., 25th, lake frozen between docks. *Providence River.*—Providence, R. I., 30th, river frozen as far down as Pawtuxet. *Chesapeake Bay.*—Baltimore, Md., 30th, ice 3 to 5 inches thick formed in harbor, large number of steamers went into winter quarters; 31st, considerable ice in bay as far south as Sandy Point; ice-boats clearing channel. Norfolk, Va., 31st, cold weather continues closing navigation in harbor and rivers. *James River.*—Dover Mines, Va., 31st, river frozen over. Along the immediate *Atlantic and Gulf coasts.*—Newburyport, Mass., 14th to 16th, floating ice in river; harbor free of ice at close of month. Boston, Mass., 31st, considerable floating ice in harbor. Wood's Holl, 30th, harbor covered with ice. New York City, 23rd, considerable floating ice in harbor and rivers. Delaware Breakwater, Del., 30th and 31st, harbor filled with floating ice. Chincoteague, Va., 31st, Assateague channel frozen over. Portsmouth, N. C., 30th, all creeks and inlets frozen over. New River, N. C., 31st, ice strong enough to bear horse and rider. *Corpus Christi Bay.*—Corpus Christi, Tex., 30th, bay frozen along shore and around wharf posts; ice 1½ inches thick. *On the Pacific coast.*—*Columbia and Willamette Rivers.*—December 4th, floating ice in river at Portland, Or., 5th, no ice in river at Portland, but on the Columbia, above the mouth of the Willamette, navigation was closed by the formation of ice. On the Columbia, below the mouth of the Willamette, navigation was closed to sea-going vessels by an ice gorge at Willow bar, though river steamers from Portland were able to reach Astoria via Willamette Slough. 11th, at noon, the ice gorge at Willow bar broke and navigation was thereby opened to sea-going vessels. 12th, navigation between Portland and the Cascades opened. At Umatilla navigation was suspended by floating ice from the 3rd to the 13th; on the 13th and 14th the river was filled with floating logs and telegraph poles, occasioned by the breaking of a boom in the Yakima River, (entailing a loss of $30,000,) but entirely free from floating ice. On the 29th navigation was again closed by floating ice. *Frazer River, British Columbia.*—Chilliwack, B. C., 5th, ice gorge, (formed during preceding cold week and piled up to a height of 20 feet,) broke during the prevalence of a warm south wind and consequent general thaw. Much damage resulted from the combined effects of the heavy rain, the melting of snow in mountains and the breaking of ice gorges in the Frazer River and tributaries.

High Tides.—Atlantic City, 21st, covered railroad tracks and meadows preventing arrival of trains; 26th, tracks and meadows again submerged, communication interrupted. Little Egg Harbor, 21st and 26th, washing out telegraph poles. Sandy Hook, 26th, undermining office building. Bangor, Me., 5th, wharves submerged. Santa Cruz, Cal., 30th, 31st, unusually high tide, followed by an extraordinary low tide, which was said to be 10 feet below average.

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the left hand side of chart No. III. Owing to ice &c., observations are wanting, as follows: Alpena, Detroit, Escanaba, Grand Haven, Sandusky and Toledo from 1st to 31st; Buffalo from 7th; Cleveland, 9th to 12th and from 17th; Milwaukee from 21st; Wilmington, 8th to 20th. Observations were taken at various times at Chicago and Marquette on 5 days, and at Duluth on 10 days.

ATMOSPHERIC ELECTRICITY.

Thunderstorms were frequent in Iowa, Missouri, Tennessee and the Ohio valley on the 4th and 5th, and the Gulf States from the 16th to the 19th; elsewhere, few or none were reported.

Atmospheric Electricity Interfering with Telegraphic Communication.—Silver City, N. M., 29th. Bismarck, 28th, very strong currents on wires in all directions. Fort Bennett, Dak., 29th, on wires in all directions.

Auroras.—The remarkable cloudiness of the month in the northern part of the United States prevented the display of auroras, even if they had occurred. At St. Vincent, Minn., however, auroras were observed on eight out of the eighteen evenings on which cloudiness did not prevail. The display of the 1st was probably general from Maine to Dakota, as it was observed at Cornish and Gardiner, Me., at Clinton, Cresco, and Independence, Iowa, Bismarck and St. Vincent. In the Lake region and the greater part of New England cloudy or stormy weather prevailed. On the 7th the aurora was observed at Newport, Mt. Washington, Cambridge, (Harvard University, a. m. of the 8th,) Mass., and at St. Vincent, Minn. Cloudy weather prevailed that night in the Lake region. On the 28th a display was noted at Eastport, Me., and Alpena, Mich., while cloudy weather prevailed at all intermediate stations. Displays were observed at Portland and Bangor, Me., on the 1st, a. m.,

Bangor, 2nd, p. m. and 3rd, p. m.; St. Vincent, Minn., 3rd, a. m., and 5th, a. m., 12th, a. m., 26th, p. m., 27th, p. m. and 29th, a. m.; Beloit, the 21st, p. m. and Rochester, 30th, a. m.

Zodiacal Light.—Connecticut.—Southington, 30th, 31st. *Cuba.*—Havana, 1st, 2nd, 3rd, 23rd, 24th, 28th, 29th. *Indiana.*—New Corydon, 6th, 7th, 9th, 11th, 30th, 31st. *Iowa.*—Cresco, 31st; Monticello, 2nd. *Kansas.*—Lawrence, 6th, 9th, 10th, 29th, 30th, 31st. Yates Centre, 1st, 2nd, 29th, 30th, 31st. *Massachusetts.*—Cambridge, 3rd, 4th, 18th, 19th, 22nd, 23rd, 28th, 30th, 31st; Rowe, 30th, 31st; Somerset, 3rd, 4th, 22nd, 23rd, 30th, 31st; Williamstown, 2nd. *Minnesota.*—St. Vincent, 2nd, 3rd, 5th, 6th, 10th, 11th, 29th. *Nebraska.*—Clear Creek, 1st, 29th, 30th, 31st. *New York.*—Waterburg, 4th, 6th, 9th, 28th. *Ohio.*—Bellefontaine, 18th, 27th, 30th, 31st. *Pennsylvania.*—Dyberry, 31st. *Tennessee*, Nashville, 2nd, 3rd, 6th, 7th, 8th, 9th, 11th, 30th, 31st. Abstract of Mr. Chas. Hasselbrink's observations at Havana, Cuba, continued from the REVIEW for September, 1880. *October*, 6th, 1880, 8 p. m., inclination 40 degrees and at 8:30 p. m., 45 degrees to the south; intermittences few and incomplete; tint *warm* to bluish white; 9 p. m., obscured. Light visible on October 25th, 26th, 30th, 31st and *November*, 1st and 23rd. November 24th, from 6:30 p. m., visible, with marked intensity, inclination 45 degrees to south; during an intermittence, that portion of the milky way previously masked by the light became more visible. 25th, of good intensity and frequent intermittence. 26th, 27th and 28th, visible; 29th, from 6:30 p. m., great intensity, whitish, cone pretty well defined, intermittences well marked, base very luminous. 30th, same as 29th, intermittences very long and return of light slow, no effluvia.

OPTICAL PHENOMENA

Mirage.—Portsmouth, N. C., 14th, exhibiting country and trees thirty miles distant. Genoa, Neb., 5th, 6th, 12th, 22d, 31st. Captain John O. Spicer, of schooner *Era*, on a voyage to Hudson's Bay and return, reports August 14th and 15th, 1879, in 67° 39′ N., 80° 08′ W., beset in ice, day pleasant and calm, land 32 miles and open water 16 miles to west; the refraction was so great that little pieces of ice in the water and the patches of snow on the land could be plainly seen, appearing to be about 6 degrees above horizon.

Halos.—From the 29th to the 31st of December, solar halos of great perfection were very generally observed in the Ohio, Upper Mississippi and Lower Missouri valleys. Halos of 22° radius and 46° radius were seen. In most cases prismatic colors distinctly appeared and parhelia or mock-suns, varying in number from two to five; brilliant contact arches were likewise observed. Halos with mock-suns were seen most frequently on the 29th in Iowa, on the 30th in Ohio, Indiana, Illinois and Missouri, and on the 31st in Michigan and Wisconsin.

MISCELLANEOUS PHENOMENA.

Meteors.—The following are the only meteors of interest reported during December, 1880: 9th, Charlotte, N. C., soon after sunset, very brilliant in southwest part of heavens; moved slowly in a westerly direction; seemed to be about the size of the crown of a man's hat and was visible for nearly 10 minutes; it did not disappear suddenly but gradually grew smaller until it vanished near the western horizon. Jacksonburg, Ohio, p. m.—very brilliant. Aiken, S. C., 5:15 p. m.—brilliant meteor like a bursting rocket; a remarkable feature was the trail, which remained visible for more than 20 minutes as noted by the watch. During such time the straight trail was apparently changed into a wavy one by the wind's action. Mayport, Fla., at sunset, meteor, of intense white light, moving slowly toward the north from the zenith; was in sight some seconds. Chattanooga, Tenn.,—observed just before sunset; very brilliant; moved from a point southeast of zenith obliquely to the eastern horizon; exploded into fiery fragments; trail, reddish hue, drifted to the west and quickly disappeared. 10th, Mayport, Fla., 3 a. m.—brilliant light from the east, illuminating whole house, shortly followed by an explosion which jarred the house and awakened the family. Fayette, Miss., 5.40 a. m.—very brilliant; passed from east to west. 11th (10th?), Savannah, Ga., 2.50 a. m.—visible for nearly a minute; moved from east to west. It apparently burst, although no noise was heard. In bursting, very large fiery balls, scattered in every direction, left a trail of vaporous smoke for a few seconds. Observers state that it completely lighted the city and presented a most dazzling sight. 12th, Pioche, Nev., 4.45 a. m., course W. by NW.; light as day for about ten seconds. 13th, Little Rock, Ark., 4.50 p. m.—brilliant meteor; altitude, 45°; moving west. Disappeared 15° above horizon. 29th, Cairo, Ill., (no time,).—very brilliant; color, green; moved from Orion southwestward, disappearing 10° above horizon, followed by a train of red light 20° long. Captain J. O. Spicer, of the schooner *Era*, in 63° 15′ N., 64° 10′ W., reports: November 12th, 1879, "at 11 p. m. saw one of the most brilliant meteors fall in the NE. illuminating the whole heavens, and at 11:45 p. m. another in the N.; many shooting stars observed all night and in all directions."

Earthquakes.—In connection with the numerous earthquakes on the Pacific coast it is noted as of possible interest, that violent eruptions of the volcano Mauna Loa, Hawaii, recommenced on December 10th, 1880. *California:* San Diego, 19th, 3:40 p. m., sharp shock—few seconds duration; motion from SE. to NW. Shocks were felt at San Luis Rey, San Juan, and Santa Anna at the same time. 21st, 11 p. m., duration few seconds; motion from SE. to NW. Los Angeles, 19th,

3:35 p. m., three shocks lasting about two seconds, with intervals of two or three seconds; motion apparently horizontal and from SE. to NW.; phenomenon more decided in country east; at San Bernardino courthouse, walls cracked from base to eaves. Campo, 21st, 11.04 p. m., sharp shock. 22nd, 3:22 a. m., sharp shock, followed by a lighter one; motion from SE. to NW., accompanied by a heavy rumbling noise like distant thunder; buildings shook so as to awaken everybody. Tecaluma, San Diego county, 26th, 2:30 p. m., slight shock; 28th, 11 p. m., severe shock. *Oregon:* Portland, 12th, between 8:40 and 8:50 p. m., slight shock in various parts of city. People were startled by the sudden rocking of their dwellings; glass pendants of chandeliers were seen to vibrate violently and several clocks were stopped; no serious damage was reported. *Washington Territory:* Olympia, 7th, 5:54 p. m.—slight shock; motion from SW., lasting a few seconds, another lighter shock reported during the night. 12th, 8:40 p. m., four shocks lasting from 9 to 15 seconds. Port Townsend, 12th, 8:30 p. m.—severe shock, "heavier than one of last week," (7th?) no damage reported. Seattle, 12th, 8:36 p. m.—severe shock, vibrations from SE. to NW. In some instances lamps vibrated four to six inches out of the perpendicular each way. Whatcomb, 27th, 3 a. m.—"Whole summit of Mt. Baker lighted up in grand style and as plain as if seen by sunlight, the fire shooting up far beyond the mountain top in bright flashes, carrying huge red sparks of lava." Bainbridge Island, 7th, 5:45 p. m., N. to S., motion wavy; 10th, 5 a. m., motion perpendicular; 12th, 8:40 p. m., N. to S., motion wavy; 14th, 7 p. m., tremulous; 20th, 11:16 p. m., wavy; 29th, 11:25 p. m., wavy; all shocks distinct but not severe. *British Columbia:* Victoria, 12th, 8:45 p. m., slight shock. *Minnesota:* St. Vincent, 28th, 1:15 a. m., vibrations like earthquake shock.

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 169 stations show 5,198 observations to have been made, of which 35 were reported doubtful; of the remainder, 4,113 or 79.2 per cent. were followed by the expected weather.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

Date—Dec., 1880.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots	
1st, 4 p. m...	0	0	0	0	0	0	2	15	
2nd, 8 a. m..	1	3	0	0	1	3	3	15	
3rd, 8 a. m...	1	5	0	0	1	5	3	10	Faculæ.
4th, 8 a. m....	2	4	0	0	0	0	5	14	Faculæ.
1 p. m....	2	3	0	0	0	0	7	25†	Faculæ. Many of the spots small.
2 p. m....	0	0	0	0	0	0	7	25†	
7th, 9 a. m	0	5	2	5	0	0	4	25	Faculæ.
9th, 9 a. m....	0	0	1	5	0	0	3	15	Faculæ.
10th, 9 a. m....	0	0	0	0	0	0	3	15	Faculæ.
11th, 1 p. m....	0	0	0	0	0	0	2	10	
12th, 1 p. m...	0	0	0	0	0	0	2	10	
15th, 9 a. m....	0	0	2	10	0	0	0	0	Faculæ. Spots probably disappeared by solar rotation.
17th, 1 p. m....	2	9	0	0	2	9	2	9	
18th, 4 p. m....	0	3	0	0	0	3	2	12	Faculæ.
19th, 9 a. m....	0	0	0	0	0	0	2	12	Faculæ.
22nd, 9 a. m....	1	1	0	0	1	1	3	4	Faculæ.
23rd, 9 a. m....	0	10	0	0	0	0	3	14	Faculæ.
27th, 4 p. m....	2	5	.....	.....	2	5	3	6	Faculæ. Spots probably re-appeared by solar rotation.
30th, 9 a. m....	0	0	0	0	0	0	3	6	Faculæ.
31st, 8 a. m....	1	4	0	0	0	0	4	10	Faculæ.

† Approximated.

NOTES AND EXTRACTS.

The following is extracted from a memoir by M. Dechevrens, S. J., on a "magnetic storm at Zi-ka-wei, near Shanghai, China, in August, 1880:"

Magnetic Perturbation of August 11th–14th, 18th and 19th, 1880.—"The perturbation of the 11th–14th, 1880, is the most important registered at Zi-ka-wei," * * * "The intensity of these perturbations in this locality, which is quite a southerly one, will be apparent, less from the absolute size of the abnormal oscillations of our magnetic needles, than from the really striking contrast of the curves, so marked and changeable, with the perfectly regular curves almost daily obtained. Indeed, the mean curves for the year 1879, which we have thought proper to place side by side with the photographic traces during the long period of disturbance might as well have been replaced by a monthly or even by a daily curve taken at random.

"The third of our variation-compasses, the *balance-magnet*, (vertical component of terrestrial magnetic intensity,) experienced, notwithstanding its slowness of motion, quite marked variations at the times of the greatest disturbance. Suffice it to say that the greatest oscillations of the balance-magnet have been simultaneous with the oscillations of the two others, that they have been in a direction contrary to those of the bifilar, showing indeed a great increase of the vertical component of intensity, whilst the horizontal component experienced a corresponding diminution: so that the general effect of the perturbation was to increase the vertical component and diminish the horizontal. On the other hand the magnetic declination, which in this place is 2° W., constantly varied inversely to the horizontal component, but with comparatively less amplitude.

"We have, then, three certain facts:—the two components of magnetic intensity have simultaneously experienced variations in contrary directions; the general effect of the perturbation has not caused any notable change in the intensity of the magnetic force of the globe, but rather in the inclination of the line of greatest force;* finally the variations of the declination are always found in opposition to those of the horizontal component of intensity, but less marked than the latter.

"It seems that these three facts can be connected and the disturbance attributed to a cause.

"In the *magnetograph* the needle of declination is naturally in the magnetic meridian, its north pole pointing to the north, but 2° to the west of the astronomic meridian; the needle of the bifilar by the torsion of the two supporting threads, has been brought into the plane perpendicular to the magnetic meridian, its north pole pointing to the west; as to the balance-magnet, it oscillates vertically in the magnetic meridian, naturally, when in horizontal equilibrium, its north pole points to the north. It follows from this arrangement, if we consider only the north poles of the magnets, that every movement of the first towards the west is caused by an increase of declination, that every movement of the second toward the south, shows a decrease of the horizontal component of magnetic intensity, while every downward movement of the third coincides with an increase of the vertical component. The first two have, therefore, constantly moved in unison or in the same direction, either from right to left or from left to right, in the first case the balance-magnet inclines its north pole, in the second it raises it and the first of these two kinds of movements especially prevailed during the perturbation of the 11th to the 14th, and that of the 18th.

"These accordant movements are very simple and do not differ from those which would be produced by a powerful magnet placed at a certain distance to the northeast or north-northeast and above the plane of the magnetograph, the north pole pointing south. Thus placed this magnet would exercise a repulsive action upon the north poles of the magnets of the apparatus, causing the magnet of declination to deviate to the west, that of the bifilar from the west to the south, and repelling downward that of the balance-magnet; moreover, we see that the action of this disturbing magnet would be quite feeble upon the unifilar, that its influence would be great upon the balance-magnet and controlling upon the bifilar, since this magnet presents itself by its two poles almost normally to the disturbing action, whilst the magnet of declination presents to it only its north pole and parallel almost in the same plane.

"This disturbing force, by changing its plane horizontally either to the right or to the left, or else by varying rapidly itself in intensity, could give rise to the very many oscillations registered by the photographic apparatus. The plate shows the similitude between the two curves of declination and the horizontal component.

"Now what could have been this disturbing force?

"Although no particular sign gave evidence of it upon our horizon, we believe that an aurora borealis of unusual intensity prevailed, especially at the time of the first perturbation; the geographical position of the earth's magnetic pole, whether to the north of America, according to the common opinion, or in Behring's Strait, as was maintained by some a few years ago, would carry far to the northeast of China the location of the disturbing force of our magnets. No one to-day is unaware that auroræ boreales or australes are almost invariably accompanied by perturbations in the elements of terrestrial magnetism, that frequently the magnetic perturbation is general over the globe, and that when such is the case an aurora australis occurs simultaneously with an aurora borealis.

"We should be exceedingly happy and thankful to receive any reliable information as to the facts in the case.

"During these two perturbations, August 11th–14th and 18th–19th, we were not able, notwithstanding the most earnest attention and the best will in the world, to discover upon the various curves of our registering barograph, thermograph or anemograph, the slightest abnormal variation which might be brought in parallel with the corresponding magnetic curves and which might, therefore, warrant us in finding any bond or connexion whatever between this important magnetic phenomenon and the concomitant meteorological phenomena. Some are inclined to attribute either to auroræ boreales or to magnetic perturbations an influence in the formation of cyclonic movements in the atmosphere or inversely. Be that as it may, the magnetic perturbation observed here in the extreme East, and which was important and general, as we shall see, left the seas of China entirely calm.

"The extent of the perturbation of the 11th–14th of August, must have been considerable, if we may judge by the following memoranda, for which we are indebted to the kindness of Mr. Helland, superintendent of telegraph lines at Shanghai. Shanghai is connected telegraphically with Europe by two cables, one entirely submarine to London via Hong Hong; the other submarine via Nagasaki (Japan) to Vladivostok, (Siberia) and aerial from Vladivostok to St. Petersburg; moreover, telegraph lines have been established throughout Japan, from Nagasaki to Hokodadi (Island of Jesso.) Now, all these lines, without exception, were affected during the magnetic perturbation recorded at Zi-ka-wei, by strong foreign electric currents. We translate the memoranda communicated to us.

"*August* 11th, 7:45 p. m. to 7:55 p. m., (Shanghai mean time) communication between Nagasaki

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* On the 12th, from 8:40 to 10:20 p. m., according to the variations of the two components of intensity, the inclination would have increased 17′ 20″, the normal daily variation rarely exceeds 2′. During the same time the magnetic declination varied at the most, only 15′.

and Shanghai interrupted; at the two stations the galvanometer shows a very strong current deflecting the needle from 10° to 15° and setting in operation the electric bells. The direction of the currents was not noted."

"*August* 12th, 7:42 p. m., the same phenomena observed at Nagasaki and Shanghai."

"From 8:40 to 9:25 p. m., communication between Vladivostok and Nagasaki interupted by foreign currents circulating in the cable: they are negative at Vladivostok. Positive current at Nagasaki from 8:40 to 8:55 p. m., then negative current, disappearing at 9:46 p. m."

"8:25 p. m., trouble in the cable from Nagasaki to Shanghai; negative currents in Japan, positive at Shanghai; maximum intensity at 9:16 p. m."

"From 8:25 to 9 p. m., strong currents in the Shanghai—Hongkong cable, positive to the north, negative to the south. The same phenomenon observed at Gutzlaff, (near Yang-tse-kiang): positive currents were observed in the two cables of Nagasaki and Hongkong. The Hongkong cable became free at 9:30 p. m., but the trouble continued in the Nagasaki cable up to 10 p. m., the time the office closed."

"Strong foreign currents were also observed on the aerial lines of the Japanese empire, from 8:30 to 6:30 p. m., of the 12th, reaching northward as far as Jesso."

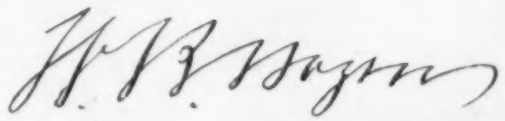
To the preceding indications we add a short memorandum of magnetic observations, received from the executive officer on board the American steamer "Ticonderoga," the vessel being at anchor in the port of Nagasaki.

"*August* 11th, at 7 p. m., (Nagasaki time—6:25 p. m., Shanghai time.) I observed a peculiar damping of my needles in amplitude to the north, and a slight vertical oscillation of the suspended needle."

The above communication of the Superintendent of telegraphs ends with these words: "The following days nothing extraordinary was noticed on the lines." Having been written on the 4th of September, this last information would lead us to suppose that the short magnetic perturbation of August 18th was of slight importance.

"We have reason to hope that, thanks to the enlightened zeal and kindness of the Superintendent of telegraphs at Shanghai, we shall have in the near future abundant facts to compare and discuss."

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.



Chief Signal Officer.

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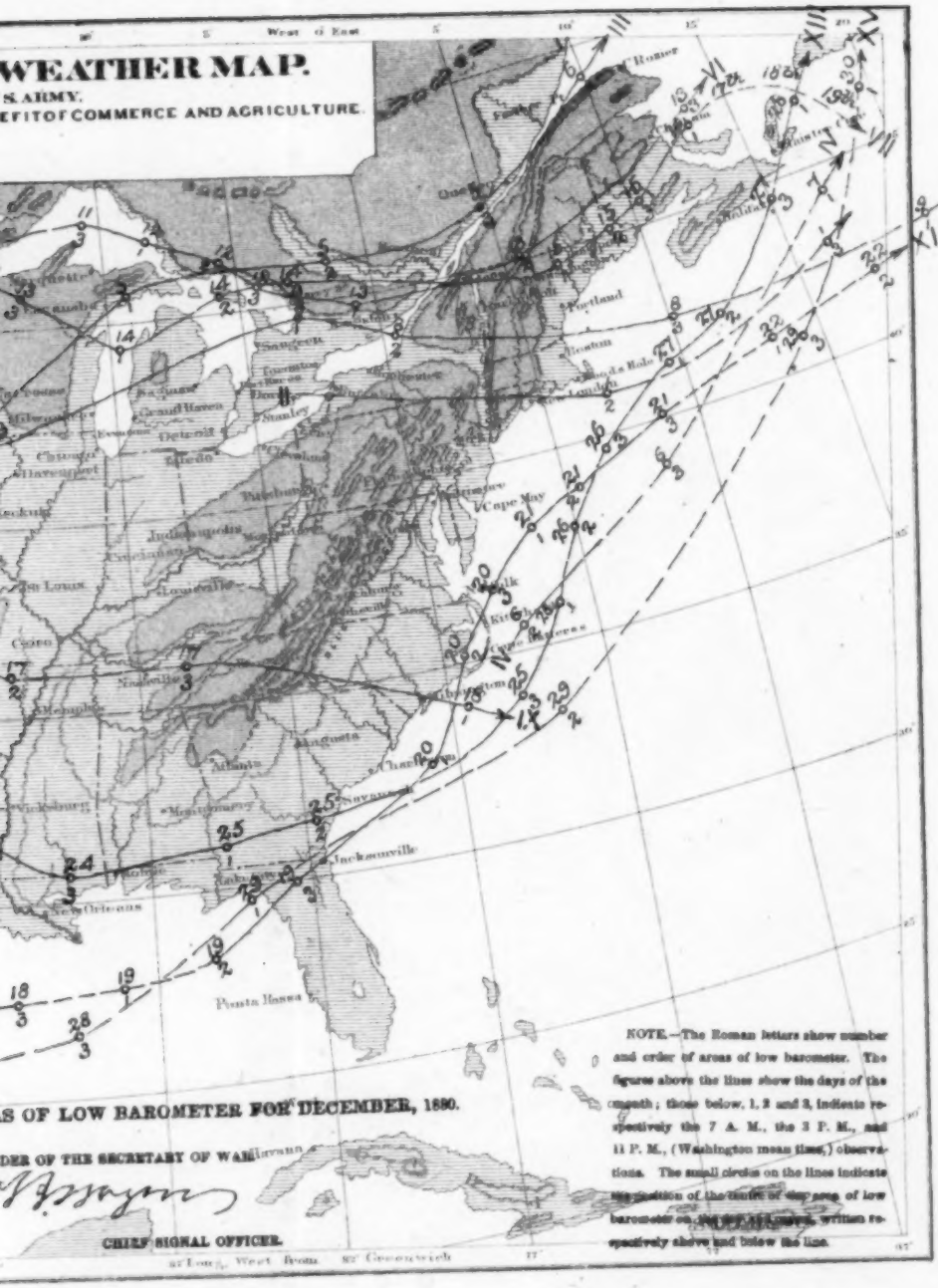
WAR DEPARTMENT WE
SIGNAL SERVICE, U.S. ARM
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER EAST OF THE 105TH MERIDIAN.
No. | Velocity.
II. 45 miles per hour.
III. 40 do.
V. 32 do.
VI. 23 do.
VII. 29 do.
IX. 47 do.
XI. 26 do.
XIII. 31 do.
XV. 75 do.
TRACKS OF CENTRES OF AREAS OF LO
PUBLISHED BY ORDER OF THE

No. I.



S OF LOW BAROMETER FOR DECEMBER, 1880.

DER OF THE SECRETARY OF WAR

CHIEF SIGNAL OFFICER.

NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the days named, written respectively above and below the line.

STATIONS.	Temperature at 8o'clock. Max.	Min.	Average daily deviation for the month.
*Alpena	36	24	
Augusta	44	24	10
Baltimore	48	34	11
*Buffalo	38	33	9.6
Burlington, Vt.	42	32	12
Cedar Keys	70	44	10.6
Charleston	66	42	9.6
*Chicago	33	33	8
Chincoteague	46	29	
*Cleveland	34	32	10
*Detroit			
*Duluth	34	32	10.6
*Del. Breakwater	43	29	
Eastport	44.5	37	17.5
*Escanaba			
Galveston	65.5	37	14.6
*Grand Haven			
Jacksonville	65	51	10
*Key West	80	68	7.9
*Marquette	33	33	11
*Milwaukee	34.5	31	8
Mobile	56	42	14.6
New London	43	25	13.6
New York	44	29.5	12.6
Norfolk	51	29	12
Portland, Maine	37	22.5	16
Punta Rassa	78	55	11.8
*Sandusky			
San Francisco	53.5	50	20
Savannah	56	38	13.5
Smithville	55	40	10
*Toledo			
*Wilmington	53	29	15
Wood's Hole	40	29	8

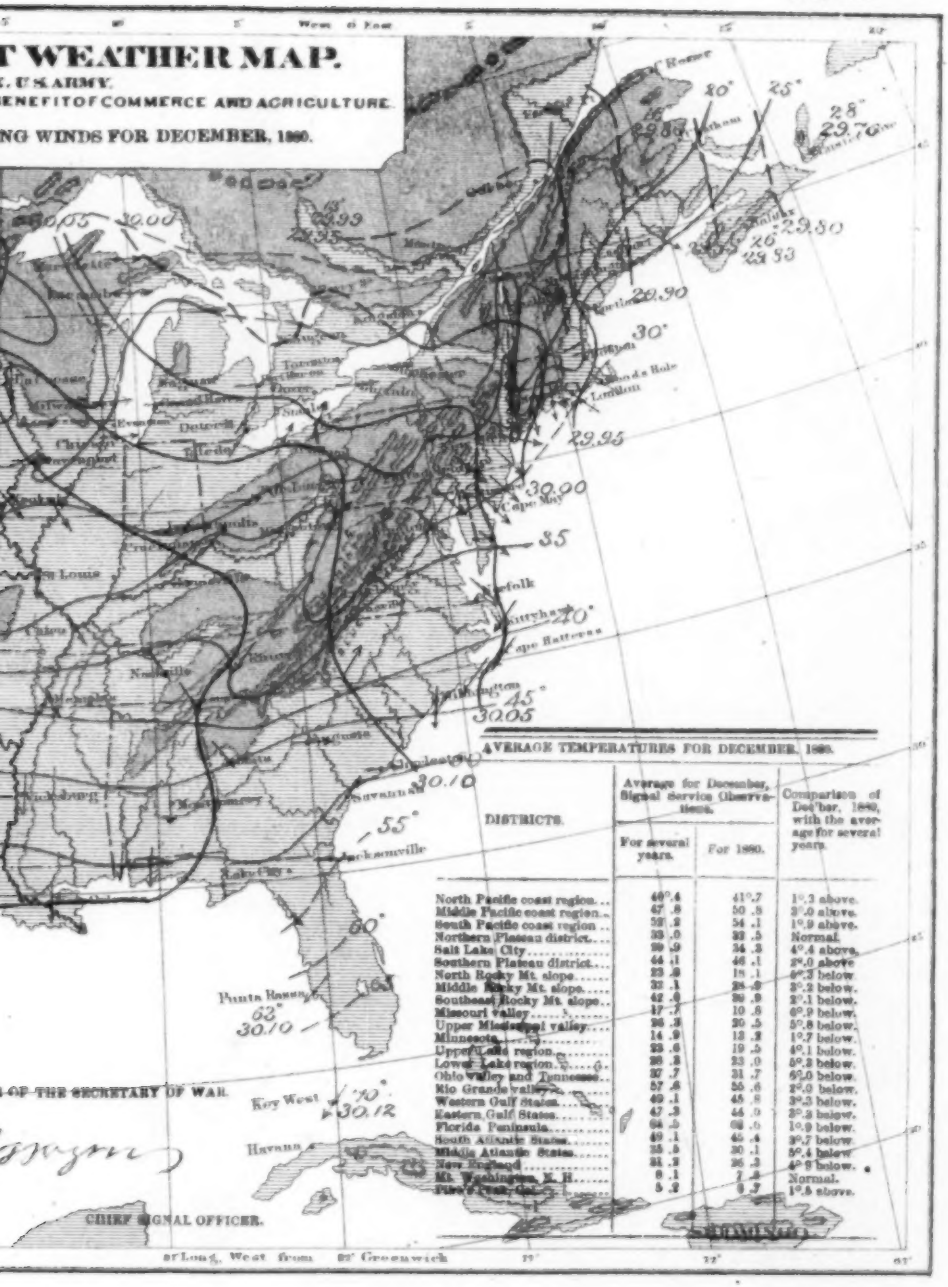
* Observations for only part of month—See text.

T WEATHER MAP.

. U.S.ARMY.

ENEFIT OF COMMERCE AND AGRICULTURE.

NG WINDS FOR DECEMBER, 1880.



AVERAGE TEMPERATURES FOR DECEMBER, 1880.

DISTRICTS.	Average for December, Signal Service Observations.		Comparison of Dec'ber, 1880, with the average for several years.
	For several years.	For 1880.	
North Pacific coast region	46°.4	41°.7	1°.3 above.
Middle Pacific coast region	47 .8	50 .8	3°.0 above.
South Pacific coast region	53 .2	54 .1	10.9 above.
Northern Plateau district	33 .0	33 .5	Normal.
Salt Lake City	39 .9	34 .3	4°.4 above.
Southern Plateau district	44 .1	46 .1	2°.0 above
North Rocky Mt. slope	23 .9	18 .1	6°.3 below.
Middle Rocky Mt. slope	33 .1	28 .9	3°.2 below.
Southeast Rocky Mt. slope	42 .0	36 .9	3°.1 below.
Missouri valley	17 .7	10 .8	6°.9 below.
Upper Mississippi valley	26 .3	20 .5	5°.8 below.
Minnesota	14 .9	13 .2	1°.7 below.
Upper Lake region	23 .6	19 .5	4°.1 below.
Lower Lake region	28 .3	23 .0	5°.3 below.
Ohio valley and Tennessee	37 .7	31 .7	6°.0 below.
Rio Grande valley	57 .6	55 .6	2°.0 below.
Western Gulf States	49 .1	45 .8	3°.3 below.
Eastern Gulf States	47 .3	44 .0	3°.3 below.
Florida Peninsula	64 .5	64 .5	10.0 below.
South Atlantic States	49 .1	45 .4	3°.7 below.
Middle Atlantic States	35 .5	30 .1	5°.4 below.
New England	31 .3	26 .3	4°.9 below.
Mt. Washington, N. H.	0 .1	7 .3	Normal.
Pike's Peak, Col.	5 .2	6 .7	1°.5 above.

OF THE SECRETARY OF WAR.

St Louis, West from St Greenwich

WAR DEPARTMENT WEA

SIGNAL SERVICE, U.S. ARM

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF C

PRECIPITATION CHART FOR DECEMB

AVERAGE PRECIPITATION FOR DECEMBER

DISTRICTS.	Average for December. For many years.	For 1880.	Comparison of December, 1880, with the average for many years.
	Inches.	Inches.	Inches.
New England	3.02	3.98	
Middle Atlantic States	3.26	4.41	1.15 excess.
South Atlantic States	4.53	4.07	0.46 deficiency
Florida Peninsula	2.00	2.24	0.24 excess.
Eastern Gulf States	4.59	4.98	0.39 excess.
Western Gulf States	4.80	2.70	2.09 deficiency.
Tennessee	4.19	3.14	1.05 deficiency.
Ohio Valley	3.70	3.08	0.62 deficiency.
Lower Lake Region	2.77	1.91	0.86 deficiency.
Upper Lake Region	1.91	1.55	0.36 deficiency.
Upper Mississippi Valley	1.76	1.38	0.38 deficiency.
Minnesota	1.26	1.68	0.42 excess.
Lower Missouri Valley	1.81	0.83	0.98 deficiency.
Upper Missouri Valley	0.79	1.09	0.30 excess.
North Pacific Coast Region	7.94	12.96	5.02 excess.
Middle Pacific Coast Region	5.98	13.23	7.25 excess.
South Pacific Coast Region	1.90	4.58	2.63 excess.

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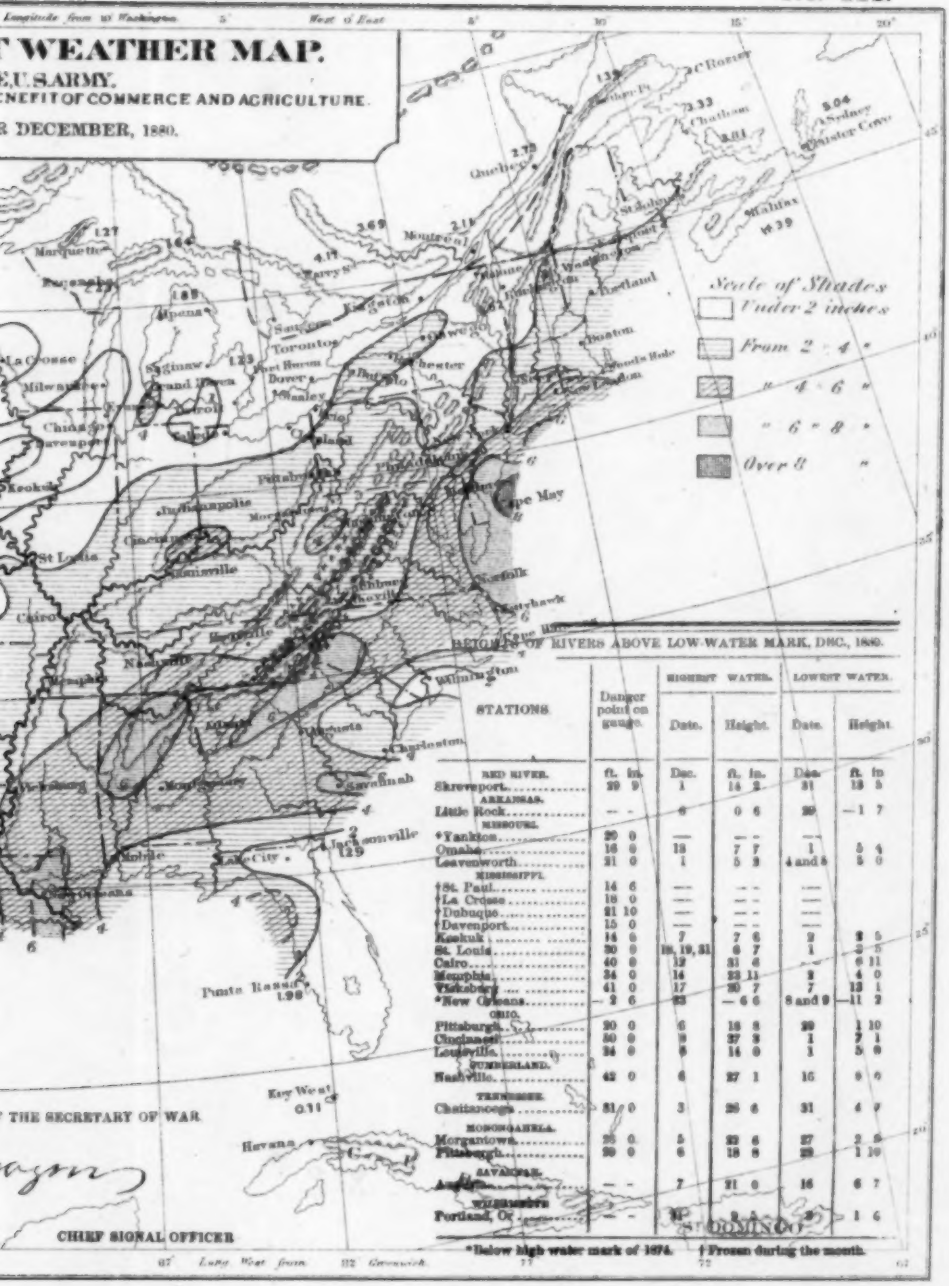
CH

T WEATHER MAP.

E, U.S.ARMY.

CNEFIT OF COMMERCE AND AGRICULTURE.

8 DECEMBER, 1880.



HEIGHTS OF RIVERS ABOVE LOW-WATER MARK, DEC., 1880.

STATIONS	Danger point on gauge	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
	ft. in.	Dec.	ft. in.	Dec.	ft. in.
RED RIVER.					
Shreveport	29 9	1	14 2	31	13 5
ARKANSAS.					
Little Rock	— —	6	0 6	29	—1 7
MISSOURI.					
*Yankton	20 0	—	— —	—	
Omaha	16 0	13	7 7	1	5 4
Leavenworth	21 0	1	5 3	4 and 5	5 0
MISSISSIPPI.					
†St. Paul	14 6	—	— —	—	
†La Crosse	18 0	—	— —	—	
†Dubuque	21 10	—	— —	—	
†Davenport	15 0	—	— —	—	
Keokuk	14 6	7	7 6	2	2 5
St. Louis	30 0	18, 19, 31	6 7	1	3 5
Cairo	40 0	12	31 6	—	6 11
Memphis	34 0	14	13 11	2	4 0
Vicksburg	41 0	17	20 7	7	13 1
*New Orleans	— 2 6	23	— 6 6	8 and 9	—11 2
OHIO.					
Pittsburgh	20 0	6	18 8	29	1 10
Cincinnati	50 0	8	27 8	1	7 1
Louisville	34 0	6	14 0	1	5 6
CUMBERLAND.					
Nashville	42 0	6	27 1	16	9 6
TENNESSEE.					
Chattanooga	31 0	3	26 6	31	4 7
MONONGAHELA.					
Morgantown	23 0	5	23 6	27	2 8
Pittsburgh	30 0	6	18 8	29	1 10
SAVANNAH.					
Augusta	— —	7	21 0	16	6 7
WILLAMETTE.					
Portland, Or	— —	31	8 1	2	1 6

*Below high water mark of 1874. †Frozen during the month.

SMITHSONIAN

CHART No. IV.

INDEX TO STORM-TRACKS.

No. I. from Oct. 28 to Nov. 4, 1880.
II. from Nov. 5 to Nov. 5, 1880.
III. from Nov. 6 to Nov. 7, 1880.
IV. from Nov. 6 to Nov. 17, 1880.
V. from Nov. 15 to Nov. 20, 1880.
VI. from Nov. 18 to Nov. 27, 1880.
VII. from Nov. 24 to Nov. 27, 1880.

INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Review*.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

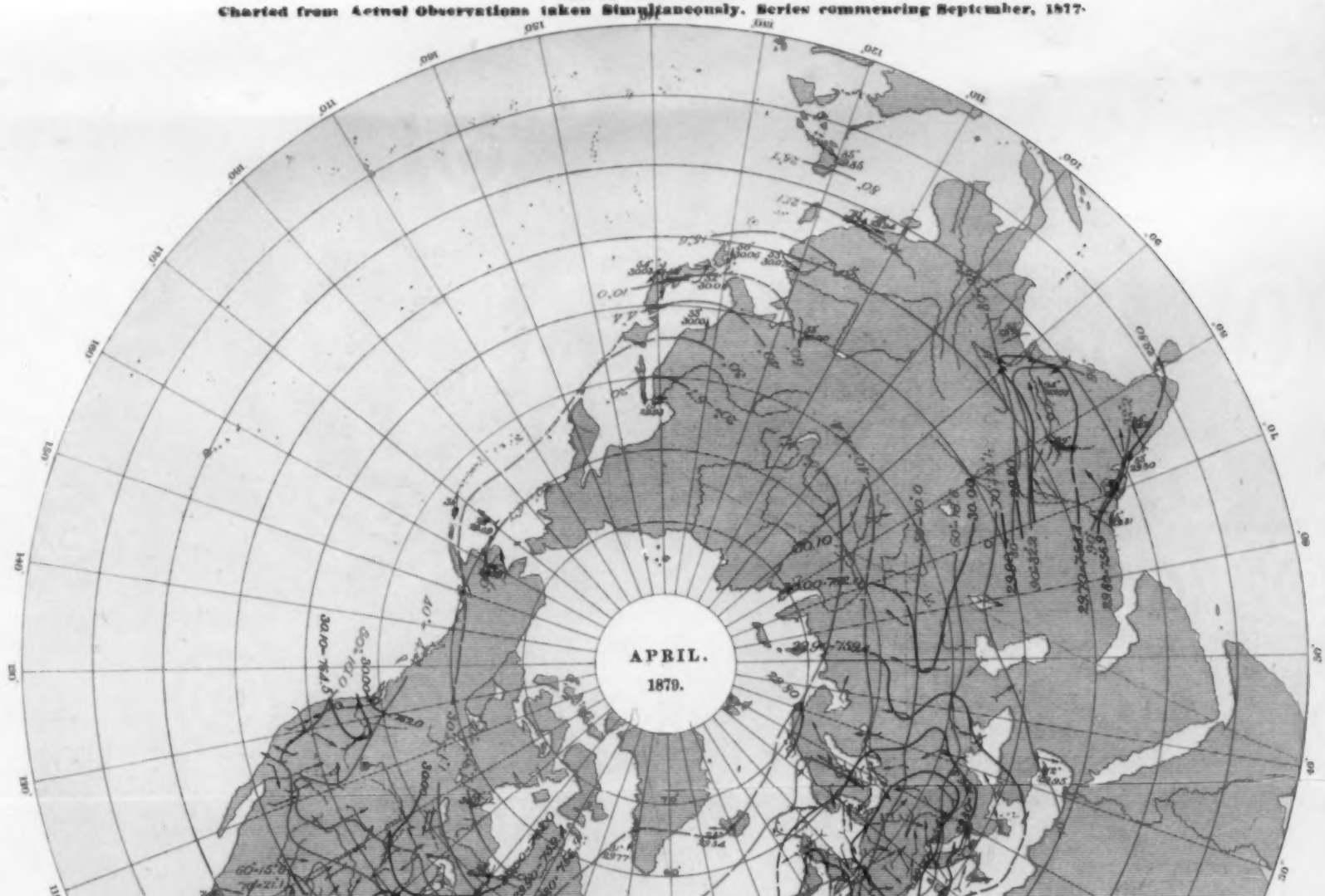
BRIG. GEN. (BVT. MAJ. GEN.) CHIEF SIGNAL OFFICER, U. S. A.

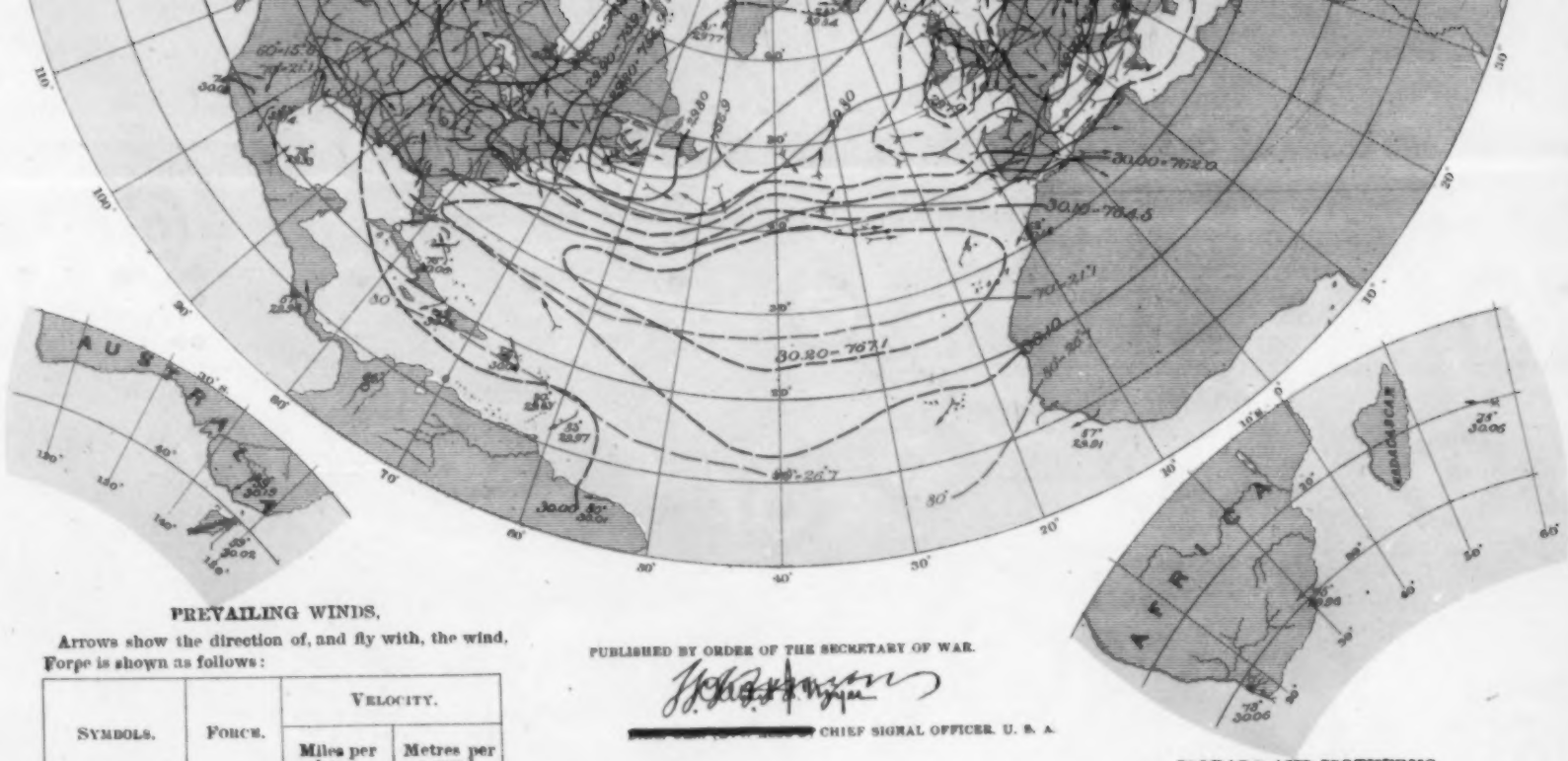
Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing September, 1877.

No. V.





PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
	1, 2	0 to 9	0 to 4.0
	3, 4	9.1 to 22.5	4.1 to 10.1
	5, 6	22.6 to 40.5	10.1 to 18.1
	7, 8	40.6 to 67.5	18.1 to 30.2
	9, 10	67.6 up.	30.2 & over.

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[redacted] CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue;* detached barometer means in English inches.

Isotherms in *red;* detached temperature means in degrees Fahrenheit.

Broken lines, are doubtful.

INTERNATIONAL MONTHLY CHART.

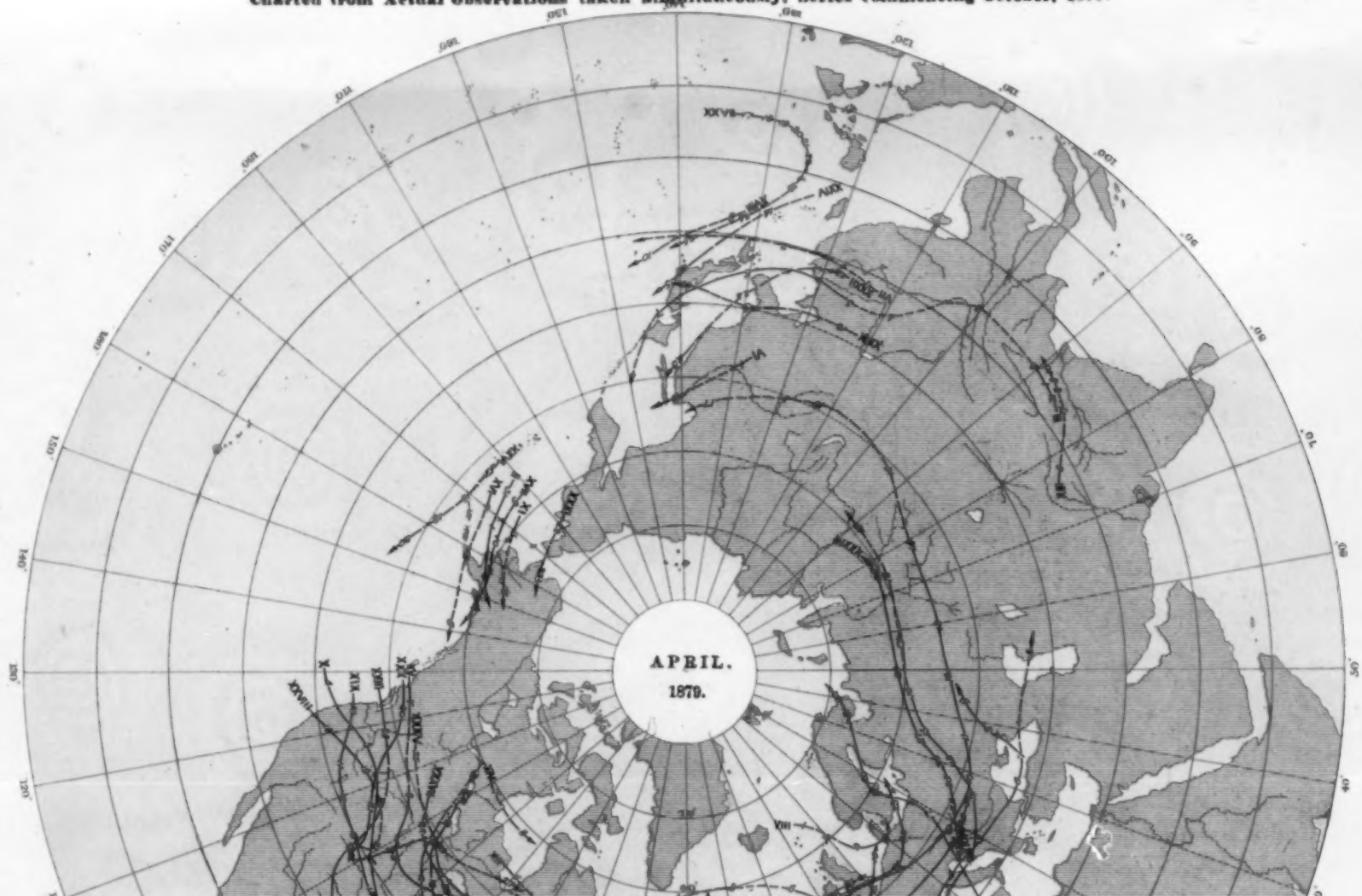
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of April, 1879, based on the daily charts of the International Bulletin.

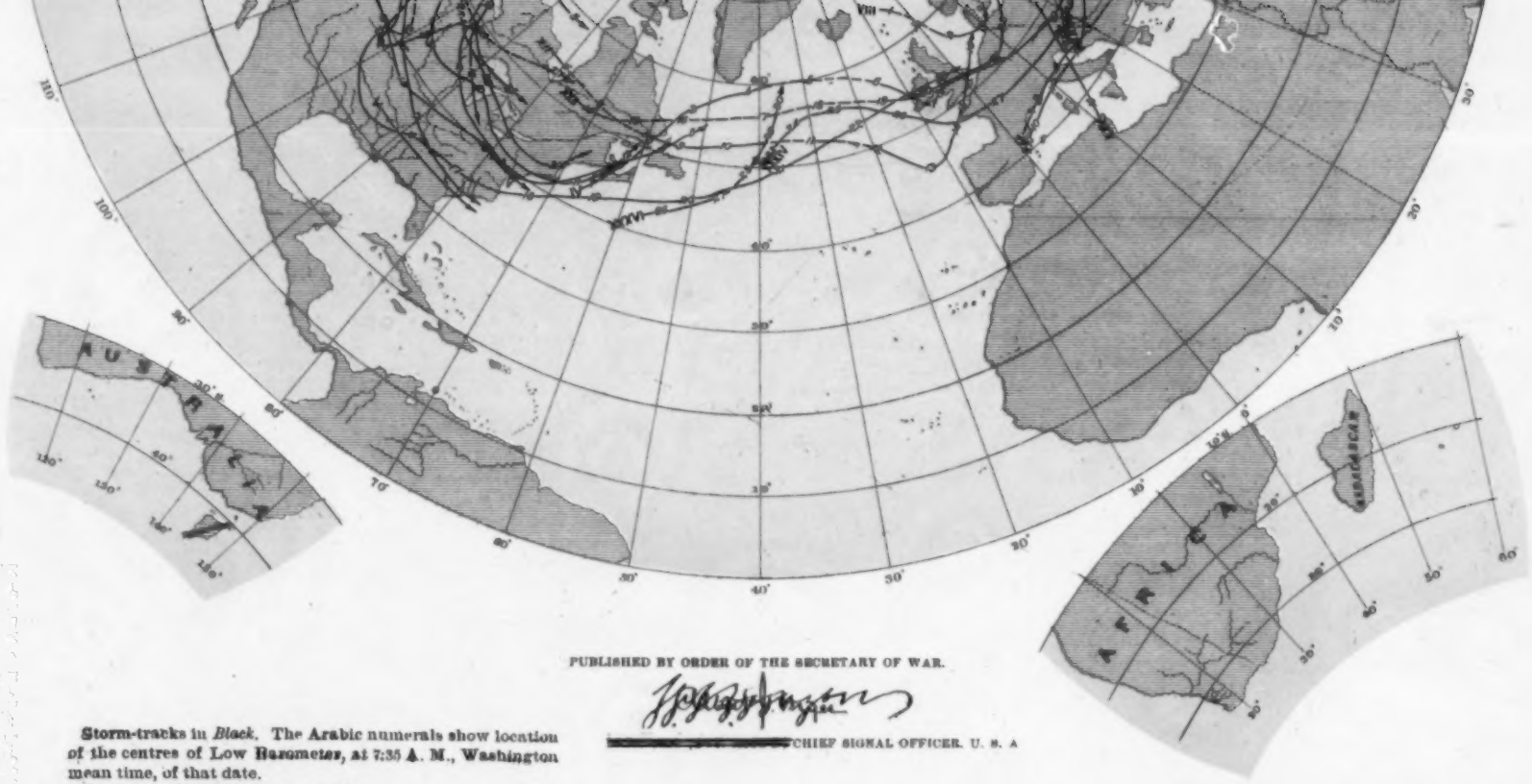
Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing October, 1877.

No. VI.





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Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for April, 1879.